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NUCLEAR SCIENCE ABSTRACTS

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NUCLEAR SCIENCE ABSTRACTS

BIOLOGY AND MEDICINE

General

17376 (ANL-6790) BIOLOGICAL AND MEDICAL RESEARCH DIVISION SEMIANNUAL REPORT, JULY–DECEMBER 1962. (Argonne National Lab., Ill.). Oct. 1963. Contract W-31-109-eng-38. 237p.

Separate abstracts were prepared for 24 sections of this report. Four sections were previously abstracted and appeared in NSA as 16: 32731; 17: 35429; 17: 40445; and 18: 3494. (C.H.)

For abstracts of individual sections see: 17377, 17378, 17379, 17380, 17381, 17396, 17397, 17398, 17399, 17400, 17462, 17463, 17464, 17465, 17466, 17467, 17468, 17469, 17470, 17471, 17631, 17632, 17633, and 18063.

17377 (ANL-6790(p.57-62)) DYNAMICS OF TUMOR GROWTH. Anna Kane Laird (Argonne National Lab., Ill.).

An analysis of data on the dynamics of tumor growth showed that the observed growth of most tumors can be schematized as an exponential proliferation of tumor cells modified by an exponentially increasing retardation that is evident throughout the growth of the tumor. Methods used in the analysis of tumor growth are described. (C.H.)

17378 (ANL-6790(p.101-12)) FRACTIONATION OF AMOEBAE IN VARIOUS MEDIA. Edward W. Daniels, Evelyn P. Brown, and Y. E. Rahman (Argonne National Lab., Ill.).

Procedures are described for the fractionation of amoeba in various media. The fine structure of protoplasmic components was preserved in the normal state in some of the media tested. (C.H.)

17379 (ANL-6790(p.171-83)) SPONTANEOUS CHROMOSOME ABERRATIONS AND THE NATURE OF NEAR-DIPLOID CELLS OF CHINESE HAMSTER (CRICETULUS GRISEUS) IN VITRO. C. K. Yu (Argonne National Lab., Ill.).

After several years of transfer and subculture in different laboratories with different media and sera, the Chinese hamster V cell strain still contains the same percentage near-diploid cells. The majority of the cells contain 23 chromosomes, and most of these possess the same chromosome pattern, which is, therefore, taken as representative of the line. However, 34 different types of chromosome constitution were found in the cells studied. With some exceptions the cells having different complements are nevertheless similar in chromosome constitution. On the other hand, cells having the same number of chromosomes may be of different patterns. The aberrations that give rise to changes in chromosome morphology and number seem to occur only on certain chromosomes and in certain regions of these chromosomes. Hence, the difference between cells having different chromosome complements depends upon the number of extra chromosomes that have appeared. The normal chromosomes of the same type present in cells of different chromosome complements are very similar. (auth)

17380 (ANL-6790(p.184-91)) PRELIMINARY EXPERIMENTS WITH THE "SPONGE TECHNIQUE" FOR ELECTRON MICROSCOPIC STUDIES OF FIBRILLOGENESIS IN THE REGENERATING TENDON. F. Wassermann (Argonne National Lab., Ill.).

Preliminary experiments showed that the gelatin sponge technique is a very useful procedure for obtaining early stages of fibrillogenesis in isolated fibroblasts in vivo as material for electron microscopic studies. The cellular processes involved in fiber formation may be influenced by local application of chemical and other agents with which the gelatin sponge can be imbibed. Experiments with the plastic sponge for studying systemic influences on the isolated cells are reported. (C.H.)

17381 (ANL-6790(p.194-204)) AN EXAMINATION OF EMBRYOLOGICAL AND MYOGENETIC DEVELOPMENT IN THE ZEBRAFISH, BRACHYDANIO RERIO (HAMILTON-BUCHANAN). Theodore N. Tahmisian, Betty Jean Wright, and Bronson R. Hall (Argonne National Lab., Ill.).

The results are presented from a study of the developmental stages of the zebrafish, Brachydanio rerio, together with a light microscope study of myogenetic sequences in formation of striated muscle in the embryo. The ultimate purpose of this study is to correlate, if possible, the myogenetic sequences in the fish with those in the grasshopper. (C.H.)

17382 (NYO-3140-1A) THE BIOCHEMICAL CIRCULATION OF ELEMENTS IN THE SARGASSO SEA. Progress Report, December 1, 1962–November 30, 1963. (Woods Hole Oceanographic Institution, Mass.). Feb. 29, 1964. Contract AT(30-1)-3140. 133p.

Progress is reported in studies on the circulation of nutrient elements in the Sargasso Sea. Methods are described for the determination of dissolved organic C in sea water and for the determination of particulate C. Data are included from studies on the composition of particulate organic matter in the Western Atlantic Ocean; cyclic diurnal variations in the uptake of ammonia and nitrate by photosynthetic organisms in the Sargasso Sea; diurnal variation of ammonia concentration in the upper 500 m of water of the Sargasso Sea; the chemical composition and carbohydrate content of zooplankton in the Sargasso Sea;

and seasonal distributions of euthecosomatous pteropods in surface plankton in the western North Atlantic Ocean. (C.H.)

17383 (UCRL-11046) BIO-ORGANIC CHEMISTRY QUARTERLY REPORT, JUNE–AUGUST 1963. (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry). Oct. 2, 1963. Contract W-7405-eng-48. 240p.

Separate abstracts were prepared for 20 sections of this report. (C.H.)

For abstracts of individual sections see: 17384, 17385, 17386, 17387, 17401, 17402, 17403, 17404, 17405, 17406, 17407, 17408, 17409, 17410, 17718, 17852, 17853, 17854, 17855, and 17868.

17384 (UCRL-11046(p.54-79)) EXPERIMENTS ON CLASSICAL CONDITIONING AND LIGHT HABITUATION IN PLANARIANS. Allan Jacobson and Reeva Jacobson (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry).

Results are reported from a series of experiments of conditioned response and light habituation in several varieties of planarians. Paired presentations of light and electric current were used as stimuli. (C.H.)

17385 (UCRL-11046(p.80-6)) OPERANT CONDITIONING IN PLANARIANS. Janet L. Alvarez, Henry Schott, and Frank T. Upham (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry).

A training apparatus for planaria is described in which the response measured was the animal's passage through a narrow beam of light directed by a photocell and the reinforcement was the termination of an intense light. Results of the studies did not show any pattern that could be interpreted as evidence of a training process. (C.H.)

17386 (UCRL-11046(p.210-15)) EFFECT OF ACRIDINE ORANGE AND VISIBLE LIGHT ON THYMINE DIMER FORMATION AND DISRUPTION. Joan Friedman (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry).

The formation and disruption of thymine dimers have been found to play a role in the uv inactivation and photoreactivation of nucleic acids. In vitro, thymine dimers can be split only by irradiation with short-wave-length uv light, whereas the in vivo phenomenon of photoreactivation, with attendant breakage of dimers, occurs with visible light plus an enzyme. Visible light must be absorbed by the enzyme and transferred by some mechanism to the dimer, since the dimer absorbs only light of wavelengths less than 2600 Å. The possibility was investigated that nucleic acid stains, such as proflavine or acridine orange (both compounds absorb visible light and bind to nucleic acids), might provide a model for this type of energy transfer. Both thymine and thymine dimer were irradiated with a photoflood lamp in the presence of acridine orange (AO) and the effect of thymine and thymine dimer on the fluorescence of AO was measured. (C.H.)

17387 (UCRL-11046(p.227-37)) STUDIES ON THE INHIBITION OF THE PHOTOREDUCTION OF FMN. G. K. Radda and Robert P. Foss (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry).

Results are reported from studies of reaction mechanisms involved in the photoreduction of flavin mononucleotide and of its analogs. The effects of a number of inhibitors on the rate of photoreduction were investigated. Possible applications of the results in studies of photosynthesis are discussed. (C.H.)

17388 (OTS-62-11755/4) JOURNAL FOR SCIENTIFIC AGRICULTURAL RESEARCH. Branko Pesic, ed. Translation of Arhiv za Poljoprivredne Nauke, 15: No. 15, (1962). 250p.

Fifteen papers are included on various topics in agricultural research. A separate abstract was prepared for one paper dealing with radioinduced mutations in Triticum species. (D.L.C.)

For abstract of individual papers see: 17484.

17389 STUDIES ON THE DOSE REQUIREMENT FOR THE RADIATION STERILIZATION OF MEDICAL EQUIPMENT. I. INFLUENCE OF SUSPENDING MEDIA. Margaret M. Burt and F. J. Lay (Wantage Research Lab., Berks, Eng.). J. Appl. Bacteriol., 26: 484-9(Dec. 1963).

Studies were designed to establish whether the efficiency of sterilization by radiation is affected by the nature of the materials being treated and the environment in which contaminants might be present. Spores of Bacillus pumilus were used since their radiation resistance is comparatively high, and data are presented for comparison of the radiation resistance of these spores dried in air from various media on to different surfaces. The media (buffer, nutrient broth, and serum) were chosen as representative, respectively, of inorganic, organic, and biological materials. Comparisons were made between several insoluble supporting surfaces, e.g., glass and polymethacrylate (Perspex), and a soluble surface in the form of polyvinyl alcohol (PVA) film. The results were compared with those obtained when the spores were suspended in buffer solution or nutrient broth under both aerated and anoxic conditions. Radiation from a ^{60}Co source was used at a dose rate of 2.4×10^5 rad/hr. The D values (the dose required to reduce the number of survivors to $1/_{10}$, i.e., 90% kill) were calculated directly from the linear part of survival curves. The D values for dried spores fall into two groups. First, spores dried from buffer, nutrient broth, or serum on to the insoluble surfaces behaved in a very similar manner, and the D values are of the same order as those obtained in liquid suspension in buffer and nutrient broth under aerated conditions; these were 0.175 (0.169 to 0.180) and 0.169 (0.162 to 0.177), respectively, (95% confidence limits in brackets). The efficiency of the radiation was not affected by changes in the degree of hydration of the spores corresponding to air-dry or aqueous conditions. However, at lower hydration levels, increase in lethal efficiency was demonstrated. Second, with each of the suspending media dried on to the soluble surface (i.e., PVA film) a comparatively higher D value was obtained; spores dried from PVA solution on to insoluble surfaces gave a similar result. The increase in resistance might to some extent be due to chemical protection, but is most probably mainly due to local anoxic conditions produced as a result of the spores being trapped in the film during drying. This situation is most likely to arise from PVA solution dried on to the PVA film, which gave the highest D value. The results compare with those obtained for suspensions in buffer, nutrient broth, and 2% (w/v) aqueous PVA under anoxic conditions; these were 0.306 (0.298 to 0.314), 0.301 (0.292 to 0.310) and 0.336 (0.322 to 0.349), respectively. It is concluded that for practical purposes of radiosterilization the radiation resistance of air-dried spores is independent of the media from which they are dried (PVA as a suspending medium presents an artificial situation) and is not influenced by the supporting surface unless it is soluble. Spores in media which preclude oxygen diffusion are probably more resistant. It is considered that the level of spore inactivation achieved at 2.5 Mrad is very satisfactory, but information

should be available regarding the initial contamination of materials being radiosterilized on a large scale. (BBB)

17390 STUDIES ON THE DOSE REQUIREMENT FOR THE RADIATION STERILIZATION OF MEDICAL EQUIPMENT. II. A COMPARISON BETWEEN CONTINUOUS AND FRACTIONATED DOSES. Margaret M. Burt and F. J. Ley (Wantage Research Lab., Berks, Eng.). J. Appl. Bacteriol., 26: 490-2(Dec. 1963).

Lethality of γ radiation at a dose rate of 2.3×10^5 rad/hr on spores of Bacillus pumilus air-dried on to a glass surface was measured by constructing dose-survivor curves. In one set of experiments the doses used were delivered without interruption, and in another set they were fractionated in various ways with storage intervals between fractions of up to one week. The results support the view that the effectiveness of radiation sterilization will not be altered by interruption of the total dose even for long periods, such as in plant operations. The results are in accord with earlier findings which showed that, whereas with very dry spore preparations irradiated in oxygen, a postirradiation oxygen effect occurs resulting in enhanced lethal damage, with an air dry situation or in aqueous suspensions no such effect is observed. Since damage induced in spores irradiated and stored in the absence of oxygen can undergo repair provided oxygen is not admitted, it is conceivable that either fractionation of dose under anoxic conditions or a continuous dose given anoxically followed by anoxic storage could lead to a lowering in lethal efficiency. (BBB)

17391 ASEPTIC ASPIRATION OF BONE MARROW FROM THE LIVING RABBIT. Edward R. Powsner and Marie N. Fly (Veterans Administration Hospital, Dearborn, Mich.). J. Appl. Physiol., 17: 1021-2(Nov. 1962).

An improved method for removing bone marrow, in sterile condition and suitable for preservation, is described. After anesthetization, the hair of the thigh is closely shaved, and the animal is thoroughly washed from the neck down with bactericidal detergent. In a room in which precautions were taken to reduce airborne contamination, the prepared limb tied in a flexed position and the shaved skin is treated with tincture of iodine. An incision 10-cm long is made over the femur between vastus intermedius and biceps femoris muscles; gauze sponges are clipped to the skin edges and turned back to exclude skin surface from the operative site. The dissection is rapidly continued through the connective tissue and fascia, and the exposed surface of the femoral shaft is scraped and then swabbed with tincture of iodine. Two small holes are drilled 4 to 5 cm apart in the exposed femoral shaft, and hypodermic needles reground to short bevels and dull points are firmly seated in the holes. The drill and needle sizes must be matched. A syringe containing salt solution is attached to one needle and an empty syringe on the other. By combined gentle pressure on the filled syringe and aspiration of the empty syringe the marrow between the two needles is readily washed into the empty syringe (with about 5 to 7 ml of washing solution). The amount of marrow obtained is usually between one and two ml. In femurs opened longitudinally after this procedure, it was apparent that the major portion of the marrow between the holes had been removed. All marrows cultured on blood agar plates showed no bacterial contamination. (BBB)

17392 VACCINATION AGAINST PARASITIC DISEASE: REACTIONS IN VACCINATED AND IMMUNE HOSTS IN DICTYOCAULUS VIVIPARUS INFECTION. William F. H. Jarrett and N. C. Craig Sharp (Glasgow Univ.). J. Parasitol., 49: 177-89(Apr. 1963).

Studies were conducted with a vaccine prepared by irradiating cattle lungworm larvae with 40-kr x-ray doses, at a dose rate of 200 r/min. Such vaccine was developed against this parasitic disease by attenuating larvae with ionizing radiation so that they retain their immunizing potential but fail to mature to produce the disease. A comparison was made between the course of infections of the normal and irradiated larvae in calves to investigate the mode of actions of, and the host's reaction to, this vaccine against bovine parasitic bronchitis which is now being widely used in the field. Approximately one-fourth of the irradiated larvae were present in the lungs 11 days after infection, but this level fell steeply until only a few stunted sterile worms with a male/female ratio of ~1:10 were found. By the time that full potency had been reached in normal infections, no worms could be found in those infected with irradiated larvae. The pathologic basis of the mild and transient clinical signs seen after vaccination is described; the stages in the development of peribronchial lymph nodes are outlined, and the relation of these to the clinical signs seen after heavy challenge in an immune animal is pointed out. The functions of these lymph node sites in antibody production are suggested. (BBB)

17393 BONE MARROW TRANSPLANTATION (BLOOD TRANSFUSION). Yoichi Ichikawa (National Inst. of Health, Tokyo). Rinsho Geka, 18: 722-33(June 1963). (In Japanese)

A review citing 71 references. (BBB)

Ecology

Refer also to abstracts 18045 and 18064.

17394 (CEA-2328) ETUDE D'UNE MÉTHODE DE DÉTECTION DU CARBON 14 NATUREL UTILISANT UN SCINTILLATEUR LIQUIDE—VARIATIONS RÉCENTES DE L'ACTIVITÉ NATURELLE DUES AU CARBONE 14 ARTIFICIEL. (Study of a Method of Detection for Natural Carbon-14 Using a Liquid Scintillator—Recent Variations in the Natural Radioactivity Due to Artificial Carbon-14). Concèle Leger (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1963. 70p.

Thesis submitted to Université, Paris.

Among the various natural isotopes of carbon, a radioactive isotope, carbon-14, is formed by the action of secondary neutrons from cosmic rays on nitrogen in the air. Until 1950, the concentration of this isotope in ordinary carbon underwent weak fluctuations of about 2–3 per cent. The exact measurement of this concentration 6×10^{-12} C/g of carbon, and of its fluctuations, are difficult, and a highly sensitive method is given using a liquid scintillator. Since 1950 this natural activity has shown large fluctuations because of the carbon-14 formed during nuclear explosions, and the evolution in France of this specific activity of carbon in the atmosphere and biosphere is examined. A study was made of the local increase in carbon activity in the atmosphere around the Saclay site, an increase caused by the carbon-14 given off as $^{14}CO_2$ by the reactors cooled partially with exterior air. (auth)

17395 RADIOACTIVITY IN HUMAN DIET. R. Scott Russell (Agricultural Research Council Radiological Lab., Letcombe Regis, Eng.). Irish J. Med. Sci., No. 439: 293-307(July 1962).

The nature of fission products and their entry into the food chain are discussed. Methods for prediction of future levels of ^{90}Sr in diet are discussed. Calculations show that in 1958 and 1959 when the rate of worldwide fallout was relatively high, the major part of the ^{90}Sr in the United Kingdom diet was due to the retention of the recent deposit

and this is expected to occur in 1962. Assessments for several other countries gave similar results. In 1960 and the early part of 1961, however, when the rate of fallout was low, ^{90}Sr entered diet mainly from the soil. Variations of ^{131}I and ^{90}Sr in the British diet, particularly in milk, are described in detail. Also described is the extensive fallout monitoring scheme in the United Kingdom. A table is provided showing ^{90}Sr content of various dietary items for 1958-60. (BBB)

Metabolism, Tissue Distribution, and Toxicology

17396 (ANL-6790(p.49-56)) PROGRESS REPORT: TUMOR DEVELOPMENT FOLLOWING INJECTION OF CARCINOGENS AT MULTIPLE SITES. Austin M. Brues, Harry Auerbach, and Georgia DeRoche (Argonne National Lab., Ill.).

Methylcholanthrene subcutaneously injected into female rats in highly carcinogenic doses (0.25 mg) had no observable effect on the time of development, growth rate, or benign nature of the benign mammary tumors that are common in these animals. The induced malignant tumors (ordinarily sarcomas) are clearly distinguished from the benign mammary tumors by their time of appearance and their growth rate. When multiple injections were given, the latent period to first appearance of a tumor was shortened, and the mean number of tumors in a group of rats and the proportion of rats with multiple tumors was increased. This can largely be explained on a statistical basis; i.e., as if each tumor develops as it would in a singly-injected rat, independently of other sites of injection or other developing tumors. There may, however, be a slight retardation of tumor development from this expectancy in animals receiving 8 injections at the same time. (auth)

17397 (ANL-6790(p.92-3)) PROGRESS REPORT: PLUTONIUM REMOVAL. VI. CHEMICAL REMOVAL OF MARROW AND ITS ASSOCIATED PLUTONIUM FROM BONE. Marcia W. Rosenthal, Joan F. Markley, and Arthur Lindenbaum (Argonne National Lab., Ill.).

A chemical technique using the protein solvent Hyamine was developed by which all organic material, including marrow, can be dissolved from bone. The technique was used in studies on the removal of injected Pu from bones of mice and rats. Results showed that removal of the organic portion of bone with its associated Pu did not remove Pu deposited in hard bone. (C.H.)

17398 (ANL-6790(p.122-5)) PROGRESS REPORT: BIOSYNTHESIS OF METHIONINE FROM HOMOCYSTEINE AND SULFONIUM DERIVATIVES IN ESCHERICHIA COLI. [PART] II. Morris Pfeffer (Argonne National Lab., Ill.).

The biosynthesis of the sulfonium compound S-adenosylmethionine by cell-free extracts of four strains of Escherichia coli was demonstrated using labeled substrates and chromatography. (C.H.)

17399 (ANL-6790(p.138-44)) PROGRESS REPORT: SOLUBLE PROTEINS FROM CELL NUCLEI. A. D. Barton (Argonne National Lab., Ill.).

Studies with the electron microscope have established the ubiquitous presence of pores in the nuclear membrane. There is evidence from many sources indicating that large molecules can and do pass through the nuclear membrane in vivo although this probably represents a process that is controlled and is not simply free diffusion. Some relatively basic proteins of moderate molecular weight are retained in the nucleus by rather loose ion-binding that may be affected by relatively small changes in the ionic concentration of the medium. The amounts of these proteins retained in the nucleus may change specifically and rapidly with changes in the physiological state of the animal. It is postulated that some of these proteins may play a role in the control of cell processes by the nucleus. (auth)

17400 (ANL-6790(p.230-2)) PROGRESS REPORT: THE BORON REQUIREMENT OF CHLORELLA VULGARIS. Landy J. McBride (Argonne National Lab., Ill.).

Preliminary results are reported from a study of the effect of boron on the growth of Chlorella vulgaris. The effects of boron on carbohydrate nutrition and photosynthesis in Chlorella were also studied. (C.H.)

17401 (UCRL-11046(p.3-6)) FURTHER ^{14}C AND ^{15}N TRACER STUDIES OF AMINO ACID SYNTHESIS DURING PHOTOSYNTHESIS BY CHLORELLA PYRENOIDOSA. J. A Bassham and Martha Kirk (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley Dept. of Chemistry).

Results are reported from a dual-tracer study of amino acid synthesis by photosynthesizing Chlorella pyrenoidosa using $^{15}NH_4^+$ and $^{14}CO_2$ as tracers. Results are reported from measurements of the ^{14}C labeling of the C-1 carbon atom of glutamic acid and the ^{15}N labeling of the amide nitrogen of glutamine. (C.H.)

17402 (UCRL-11046(p.7-14)) TWO-DIMENSIONAL HIGH-VOLTAGE LOW-TEMPERATURE PAPER ELECTROPHORESIS OF ^{14}C-LABELED PRODUCTS OF PHOTOSYNTHESIS WITH $^{14}CO_2$. Wolfgang Rohr and J. A. Bassham (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry).

Procedures are described for the two-dimensional, high-voltage, low-temperature paper electrophoresis of ^{14}C-labeled photosynthetic products. Autoradiograms of electrophotograms were prepared to demonstrate early amino acid photosynthesis in Chlorella. (C.H.)

17403 (UCRL-11046(p.15-20)) A SEARCH FOR ENZYMIC AND NONENZYMIC REACTIONS BETWEEN THIAMINE DERIVATIVES AND SUGAR PHOSPHATES. Horst Egeter (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry).

Preliminary results are reported from tracer studies of enzymic and nonenzymic reactions between thiamine derivatives and sugar phosphates. Applications in studies of photosynthetic CO_2 reduction reactions are discussed. (C.H.)

17404 (UCRL-11046(p.21-2)) THE CYTOCHROME CONTENT OF PURIFIED SPINACH CHLOROPLAST LAMELLAE. John Biggins and R. B. Park (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry).

Procedures are described for the spectrophotometric determination of cytochrome from highly purified lamellae from spinach chloroplasts. The effect of various concentrations of chlorophyll in the samples was studied. (C.H.)

17405 (UCRL-11046(p.23-6)) THE OSMIUM TETROXIDE FIXATION OF CHLOROPLAST LAMELLAE. R. B. Park (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry).

Results are reported from studies of OsO_4 fixation of chloroplast lamellae during the preparation of leaf tissues for electron microscopic examination. (C.H.)

17406 (UCRL-11046(p.27-42)) KINETICS OF EXOENZYMES AND APPLICATIONS TO THE DETERMINATION OF THE SEQUENCE OF NUCLEIC ACIDS. Charles Cantor and Ignacio Tinoco, Jr. (California. Univ., Berke-

ley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry).

The general kinetics of exoenzymes are discussed. Applications of exoenzymes to determine the base sequences of nucleic acids are reported. (C.H.)

17407 (UCRL-11046(p.43-53)) BRAIN BIOCHEMISTRY AND BEHAVIOR IN RATS. G. T. Pryor, Hiromi Morimoto, and Barbara Olton (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry).

Preliminary results are reported from a study of the relation of brain biochemistry and behavior of rats. Data are presented on the effects of the concentration of serotonin and acetylcholine and the activities of various enzymes on behavioral and genetic differences in six strains of rats. (C.H.)

17408 (UCRL-11046(p.87-9)) MANGANESE PORPHYRIN COMPLEXES. Linda K. Phillips (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry).

The preparation and reaction mechanisms of Mn porphyrin complexes were investigated. A scheme for a photoreaction is included. (C.H.)

17409 (UCRL-11046(p.101-15)) TRANSIENT RESPONSE OF LIGHT-INDUCED PHOTOSYNTHETIC ELECTRON PARAMAGNETIC RESONANCE SIGNALS: RHODOSPIRILLUM RUBRUM CHROMATOPHORES. R. H. Ruby (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry).

Use of electron paramagnetic resonance (EPR) in the examination of the physical mechanism of primary quantum conversion in photosynthesis requires that the signals observed are in fact produced in the primary energy-conversion process, as opposed to chemical reactions at a subsequent time and that the features characterizing the EPR signal may be explained in terms of the variables that describe the physical and chemical system in which the energy conversion takes place. Results are reported from preliminary experiments designed to correlate the observation of EPR in a photosynthetic system with the observation of optical-absorption changes in the same system. This information supplements positive evidence previously obtained and provides further information about variables that may be used to characterize the system. The system chosen was R. rubrum chromatophores, chosen primarily for the reproducible EPR signals it yields. (C.H.)

17410 (UCRL-11046(p.199-206)) BIOSYNTHESIS OF THE OPIUM ALKALOIDS. Robert O. Martin and Henry Rapoport (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry).

Two main microanalytical techniques, VPC flow counting and chromatography on Al_2O_3-impregnated paper, and radioautography were developed for use in studies of the opium alkaloid biosynthesis problem. The practical lower limits of mass and radioactivity detection are 0.1 μg and 120 dis/min (^{14}C) with the VPC system, and 5 to 20 μg and 200 dis/min for the paper chromatographic-autoradiographic method. The traditional extraction scheme was tested with a mixture of 10 alkaloids, of which eight were recovered in about 80% yield. Fifteen poppy plants, stunted in appearance, after 40-min exposure to 33 mC of $^{14}CO_2$, produced an alkaloid spectrum unexpectedly low in minor constituents. Only two compounds with measurable activity were thebaine (2×10^4 dis/min/μmole) and narcotine (400 dis/min/μmole). (auth)

17411 (USNRDL-TR-709) PRESENCE OF DONOR SPECIFIC γ-GLOBULINS IN SERA OF ALLOGENEIC MOUSE RADIATION CHIMERAS. L. A. Herzenberg and L. J. Cole (Naval Radiological Defense Lab., San Francisco). Feb. 2, 1964. 14p. (AD-432416)

Young adult DBA/2 mice received a single whole-body x ray exposure of 840 rad followed by an intravenous injection of 8×10^6 bone marrow cells from normal (C3H × DBA/2)F_1 donors. Control groups included syngeneic (isogenic) chimeras, i.e., DBA/2 mice which received 840 rad plus an injection of 8×10^6 DBA/2 marrow cells. Blood serum from these chimeras was collected at times up to 9 months postirradiation, and analyzed for total γ-globulin levels and for specific donor or host type γ-globulin isoantigens. Marrow-donor type γ-globulins (Igal) were found in the serum of the allogeneic chimeras at various times up to 9 months after irradiation. By contrast, the sera from the syngeneic chimeras were negative for Igal γ-globulin, and showed high levels of Iga3 γ-globulin, the DBA/2 type. It was shown also that the allogeneic chimeras were specifically tolerant to appropriate skin homografts; whereas, the syngeneic chimeras rejected both A-strain skin grafts and (C3H × DBA/2)F_1 skin grafts. (auth)

17412 (JPRS-23604) THE ABSORPTION AND SECRETION OF RADIOACTIVE CARBON (C^{14}) BY FISH. G. V. Fedorova. Translated from Biol. Nauki, No. 4, 84-9(1963). 9p. (OTS-64-21755)

Studies on carp kept for 50 days in water contaminated with ^{14}C showed that fish absorb ^{14}C from water and that the deposition of ^{14}C occurs mainly in tissues that are in direct contact with water and in liver and brain tissues. Carbon-14 was shown to be taken up by the gills and carried to various organs of the body by the blood. (C.H.)

17413 EFFECTS OF THIONINE AND WHITE LIGHT ON METABOLISM OF ASCITES TUMOR CELLS IN RELATION TO KNOWN EFFECTS OF X-RAYS OR H_2O_2. Jehu Hunter, Mark Woods, and Dean Burk (National Cancer Inst., Bethesda, Md.). Acta Biol. Med. Ger., 11: 681-99(1963).

Previous reports have indicated that certain dyes, x radiation, and H_2O_2 act similarly in reducing glycolysis of tumor cells. Thus studies were conducted on suspensions of tumor cells to elucidate the mechanism of action of these agents. These in vitro studies are preliminary to experiments in vivo in which tumor-bearing animals are injected with low, pharmacologically nontoxic dosages of dye and then selectively illuminated with collimated or lasered visible light with a view to obtaining photochemotherapeutic effects on the tumors, comparable to conventional in vivo radiotherapeutic effects with x rays and other ionizing radiation. Metabolic effects induced by thionine in the presence and absence of white light were observed with Ehrlich and Krebs-2 ascites tumor cells incubated in Krebs-Ringer bicarbonate-glucose medium. The metabolic effects varied greatly as a function of the dye and tumor cell concentrations, as well as the intensity of light. Observations suggest that viability loss may not be due primarily to the effect of H_2O_2 produced by x rays (or thionine ± white light), but that some more subtle derangement in the metabolic processes of the cell occurs. (BBB)

17414 RESEARCH OF THE I^{131}-LABELING OF LACTIC DEHYDROGENASE. A. D'Addabbo and D. Klaus (Medizinische Klinik and Poliklinik, Tübingen, Ger.). Acta Isotopica, 1: 39-53(Mar. 1961). (In German)

Lactic acid dehyrogenase (LDH) from rabbit muscle in crystalline suspension was labeled by the method of Banks, Seligman, and Fine. The enzymatic activity decreased sig-

nificantly; this loss was attributed to denaturation of the enzyme by the CCl_4 containing the $^{131}I_2$, with which the enzyme was shaken during the labeling, and not to inactivation by β and γ rays from the decay of ^{131}I. Suitable controls demonstrated this explanation. When 7 ml dialyzed LDH solution was shaken carefully for 3 to 5 min with 0.5 ml CCl_4 solution after 0.2 ml 1.25% Na_2CO_3 was added, workup by addition of 0.1 ml 1N acetic acid, 60-hr dialysis against Tyrode solution at 4°C, and centrifugation gave optimal labeling: radioactive yield 1.72%, ^{131}I activity 11 μc/mg, 4.1% enzyme activity remaining. Paper electrophoresis of LDH-^{131}I shows four bands; that with greatest activity is in the region of γ-globulins from added human serum and the initial point; the other three are in the region of α_2- and β-globulins. After intravenous injection in the rabbit, two phases of elimination from serum are observed; in the first, the half lives of enzyme activity, serum radioactivity, and ^{131}PBI are 78.1, 33.8, and 21.6 min respectively; in the second, 332.0, 303.0, and 247.0 min respectively. The difference between enzyme activity and ^{131}PBI in the first phase is attributed to more rapid elimination of the denatured LDH-^{131}I; these two activities in the second phase are the same. Organs contained the following ^{131}I activity 24 hr after injection: liver, 0.99% of original dose; kidneys 0.58%, lungs, 0.22%; spleen, 0.01%; erythrocytes, 0.0%. (BBB)

17415 STUDIES ON CALORIC TOTAL EXCHANGE, THYROID UPTAKE OF ^{131}I AND PLASMA RADIOTHYROXINE HALF-LIFE IN RATS. EFFECTS OF PREPUBERAL AND POSTPUBERAL CASTRATION. L. Semprebene, G. A. Benedetti, P. Pavoni, and D. Andreani (Universita, Rome). Acta Isotopica, 3: 29-39(1963). (In Italian)

The energetic exchange, the thyroid uptake of radioiodine, and the plasmatic half life of 1-thyroxine-^{131}I were determined in 130 male rats castrated either before or after puberty as well as in 62 normal rats. In comparison with the normal animals, in castrated rats lower oxygen consumption, higher thyroid uptake, and longer half life of radiothyroxine were observed. Rats castrated in postpuberal age showed more significant differences. It is suggested that the absence of testicular secretion hinders the utilization of thyroxine in tissues. (auth)

17416 COMPARATIVE TOXICITY OF STABLE RARE EARTH COMPOUNDS. III. ACUTE TOXICITY OF INTRAVENOUS INJECTIONS OF CHLORIDES AND CHELATES IN DOGS. Joseph G. Graca, Frederick C. Davison, and John B. Feavel (Ames Lab., Ames, Iowa). Arch. Environ. Health, 8: 555-64(Apr. 1964).

Stable rare earth chlorides, citrate, and EDTA salt complexes were injected into a total of 135 anesthetized dogs. All rare earths, except promethium, were included. Yttrium was also included in the series. An amount of 100 mg/kg doses was administered intravenously as 5% solutions, in 10 mg/kg increments at 10-min intervals. Observations were made on heart rate, blood pressure, and respiration. Blood samples were taken preanesthetically, and at 0, 10, 30, 60, 100, and 160 min for red blood cells, white blood cells, and differential counts, hemoglobin, hematocrit, sedimentation rate, prothrombin time, and coagulation time. No distinctive physiological response was found with any of the rare earths. Specific effects on blood constituents were an increase in prothrombin and coagulation times. The other constituents were not specifically affected by the rare earths. The chlorides were most toxic and the edentate complexes the least. Acute toxicity was of a low order; however, latent symptoms and pathology were found in single-injection preliminary studies. There also was a gradation of decreasing effects from the lower to the higher members of the atomic series. Gross and histopathological examinations were essentially negative. (auth)

17417 A CONTRIBUTION TO THE ANALYSIS OF THE PASSIVE PERMEABILITY OF THE ERYTHROCYTE MEMBRANE TO ALKALI METAL IONS. K. Pfleger, W. Forth, and W. Rummel (Pharmakologisches Institut, Homburg/SAAR Ger.). Arch. Exptl. Pathol. Pharmakol., 245: 64 (1963). (In German)

Permeability of erythrocytes of the strophanthin-treated rabbit to ^{22}Na, ^{42}K, ^{86}Rb, and ^{137}Cs was studied. Passive permeability of the erythrocyte membrane for these ions decreased with increasing size of the ion; thus, the permeability constant varied with the reciprocal value of the surface area, calculated from the radius of the ions. No correlation between these constants and the hydrated radius of the ions was found, indicating that the ions traverse the red cell membrane in nonhydrated form. Since removal of the hydration shell requires energy, it appears that the Q_{10} value for passive permeability of the erythrocyte to cations is > 2. (BBB)

17418 EXPERIMENTAL CONTRIBUTION TO THE CLARIFICATION OF THE REASONS FOR CONCENTRATIONS OF Cs^{137} AFTER RADIOACTIVE FALLOUT. K. Pfleger, W. Forth, E. Oberhausen, and W. Rummel (Pharmakologisches Institut and Institut für Biophysik, Homburg/Saan, Ger.). Arch. Exptl. Pathol. Pharmakol., 246: 77(1963). (In German)

As a result of atomic explosions, ^{137}Cs is found in food. It is concentrated in humans in preference to K. Studies of influx and efflux in erythrocytes have shown no explanation for the deposition seen in humans. For each Cs^+ ion, 4.5 K^+ ions enter erythrocytes, and 1.5 K^+ ions leave, so that at distribution equilibrium there is 3 times as much Cs^+ as K^+ in serum. Study of ^{137}Cs and ^{42}K distribution after 48 hr., as well as after chronic feeding for 8 weeks of a diet in which the $^{137}Cs:K^+$ ratio is constant, showed that ^{137}Cs is preferably concentrated in all organs except for the central nervous system and erythrocytes. The very high $^{137}Cs:K^+$ ratio of kidney indicated that K, Rb, and Cs are efficiently excreted by kidney. A mixture of ^{42}K, ^{86}Rb, and ^{137}Cs with carrier and with creatinine was injected directly into the renal arteries of narcotized dogs. The urine was collected by ureteral catheterization. The Cs^+ and Rb^+, like K^+, appeared before the creatinine. These were secreted by the tubules. Until the appearance of creatinine, one Cs^+ ion was excreted with five Rb^+ and 10 K^+ ions. The Cs^+ excretion lasted longer than the K^+ excretion. Integration of the excretion curve showed that ~3 K^+ ions were excreted for each Cs^+ ion. In this way the kidneys are responsible for the retention of Cs in the body. Since the $Cs^+:K^+$ ratio was higher in muscle and liver than in serum, these tissues must have an additional mechanism for Cs retention. (BBB)

17419 CLINICAL MEASUREMENT OF BRAIN UPTAKE OF RADIOISOTOPE. William H. Oldendorf and Masami Kitano (Univ. of California, Los Angeles). Arch. Neurol., 9: 574-84(Dec. 1963).

A new technique and apparatus are described that allow the estimation of the rate of diffusion of a γ-emitting-isotope-labeled substance from circulating blood into brain tissue. The technique consists of giving a small amount of γ-emitting radioisotope intravenously and following the total cranial content as the blood level falls. Initially the entire cranial isotope content will be in the circulating blood pool and none in the noncirculating tissues. By subtracting the blood contribution to the total cranial content it is possible to measure the noncirculating cranial tissue content. Con-

struction of the device by which the total cranial isotope content is monitored is explained. The subject is positioned relative to NaI crystal detectors using the external auditory meatus and the bridge of the nose as reference points. Two large Tl-activated NaI crystals ($6 \times 2 \times 1\frac{1}{2}$ in.) are recessed 5 cm in a solid lead shield with their long axis approximately paralleling the long axis of the brain mass. Photomultiplier tubes are coupled to one end of each crystal, and scintillations produced by γ rays interacting with the crystals produce voltage pulses which are counted electronically and recorded on a digital printer at 30-sec intervals. Only photons with an energy level above ~200 kv are recorded. Lead correcting plates (dimensions $4 \times 20 \times 75$ mm) are arranged to aid in flattening the field by minimizing the pickup from the lateral superficial tissues. With this arrangement of crystals and correcting plates the combined output of the two crystals gives a reasonably uniform sensitivity for all regions of the cranial portion of the head and all depths when used with γ radiation in the region of 0.25 to 0.5 Mev. The sensitivity of this system was mapped in a water-filled phantom of the human head. The cranium is considered in this technique as a two-compartment system. To obtain the content of the noncirculating compartment the total cranial count is obtained, and the blood contribution to this count is subtracted from it. The assumption is made that at some early time (such as 2 min) all of the cranial count is in the blood compartment. The noncirculating (tissue) content is then zero. As the total count falls the contribution from the blood is subtracted, and a tissue isotope curve is constructed. The substances studied included readily available radioisotopes, such as o-iodinated (^{131}I) sodium hippurate, ^{131}I-serum albumin, ^{131}I-Rose Bengal, ^{203}Hg-chlormerodrin (Neohydrin), ^{75}Se-selenomethionine, and ^{64}Cu acetate. The technique requires extremely small amounts of radioisotope (1 to 2% of that for a brain scan), and requires only antecubital venipuncture. It was more quantitative with materials which do not disappear rapidly from the blood, such as chlormerodrin. The increased brain ^{64}Cu uptake in a case of Wilson's disease (hepatolenticular degeneration), compared with normal controls, was shown. (BBB)

17420 BIOSYNTHESIS OF LABELED CARBOHYDRATES AND OTHER COMPOUNDS OF BIOCHEMICAL INTEREST. S. Abraham (Univ. of California, Berkeley). Atomlight, No. 36: 1-16(Mar. 1964).

Compounds recently prepared by biological methods are mentioned, and the synthesis of glucose-3,4-^{14}C is described in detail. The preparation of this hexose with ^{14}C in carbons 3 and 4 by conventional organic chemical methods is extremely difficult. (auth)

17421 TISSUE DISTRIBUTION AND CONCENTRATION OF ^{14}C-LABELED CYCLOPHOSPHAMIDE: A PRELIMINARY REPORT. J. L. Rabinowitz, R. M. Myerson, and H. P. Close (Veterans Administration Hospital, Philadelphia). Atompraxis, 10: 123-5(Mar. 1964).

The tissue distribution and concentration of intravenously administered ^{14}C-labeled cyclophosphamide were studied in 10 patients. Higher concentrations were found in tumor tissue than in normal tissue. The plasma concentration is approximately 10 times that of the cellular components of the blood. Leukemic leukocytes have approximately 50% higher concentration of cyclophosphamide than do erythrocytes. The concentration of the compound within the blood is lost rapidly. Cyclophosphamide crosses the blood-brain barrier and its concentration in the spinal fluid is higher than that of blood. (auth)

17422 INCORPORATION OF RADIOACTIVELY LABELED PHOSPHATE AS AN INDICATION OF METABOLIC CONDITIONS IN THE LIVER. E. Boquoi (Universität, Munich). Atompraxis, 10: 134-7(Mar. 1964). (In German)

Various chemical and biological factors cause an increase in uptake and incorporation of radioactively labeled phosphate in the rat liver after intraperitoneal injection. This effect was shown by groups of heterogeneous substances: cytistatic substances (N-Lost Mitomen, Endoxan, TEM, E_{39}); substances causing liver damage (CCl_4, allyl formate, and ethionine, as well as the anesthetic avertin); lyophilized liver cells and organ homogenates; total-body x irradiation; and partial ($^2/_3$) hepatectomy. Morphological damage to the liver was demonstrable under a light microscope only in regard to those substances known to cause hepatic damage: CCl_4, allyl formate, and ethionine. The total incorporation of phosphate in high-molecular substances, and a corresponding increase in this process, is proportional to the phosphate uptake. The increase in phosphate uptake is possibly the result of varying effective mechanisms, with varying points of attack. (auth)

17423 THE DEPENDENCE OF THE AGE OF ERYTHROCYTES ON THEIR ^{51}Cr-UPTAKE. H. Kuni, E. H. Graul, and H. Hundeshagen (Philipps-Universität, Marburg an der Lahn, Ger.). Atompraxis, 10: 137-40(Mar. 1964). (In German)

A fractionating of ^{51}Cr-labeled erythrocytes of different age by centrifugation has shown an increasing Cr-uptake with increasing age. Therefore the special form of the ^{51}Cr-Ery-Vita-curve cannot be fully explained by an elution of the Cr. (auth)

17424 TRITIATED THYMIDINE TOXICITY IN MAMMALIAN SYSTEMS. L. D. Samuels, W. E. Kisieleski, and R. Baserga (Public Health Service, Rockville, Md.; Argonne National Lab., Ill.; and Northwestern Univ., Chicago). Atompraxis, 10: 144-8(Mar. 1964).

Tritiated thymidine has received wide usage during the past five years, with varied concern for its toxicity. Current literature is reviewed for evidences of tritiated thymidine toxicity when administered to mammalian systems. Included are unpublished observations of the authors. Mutagenesis, carcinogenesis, growth inhibition, various cytological anomalies, and cell death were observed following exposure to tritiated thymidine. Problems of calculating radiation dose from tritiated thymidine are mentioned, and the suggestion is made that considerable caution is needed in its use. (auth)

17425 COBALT- AND VITAMINE B_{12}-METABOLISM. III. INVESTIGATIONS ON THE COPROPHAGY OF CHICKEN AFTER APPLICATION OF $^{60}CoCl_2$. W. Steffens and K. H. Menke (Arbeitsgruppe Landwirtschaft, KFA-Julich, Ger. and Universitat, Bonn). Atompraxis, 10: 152-7(Mar. 1964). (In German)

Ninety-two chickens receiving 0.2 μC $^{60}CoCl_2$ daily grew up with the same number of untreated chickens. Coprophagy was calculated from the radioactivity. The radiation dose had only a slight effect on the growth rate. (auth)

17426 STUDIES ON THE NUTRITIONAL ROLE OF SELENIUM. I. THE DISTRIBUTION OF RADIOACTIVE SELENIUM IN MICE. G. B. Jones and K. O. Godwin (Univ. of Adelaide). Australian J. Agr. Res., 14: 716-23(Sept. 1963).

Mice were fed leaves of a plant that had been grown in a solution containing ^{75}Se. The ^{75}Se was incorporated in the organic matter of the plants and was given to the mice in

physiologic amounts. The plant lucerne (Medicago sativa) was fed to the mice, and the distribution of ^{75}Se among various organs was studied. On the basis of ^{75}Se activity per unit wet weight, the importance of the liver and kidney as metabolic sites is confirmed, and the pancreas, endocrine glands, and stomach wall are additional sites where ^{75}Se is taken up in comparable concentrations. The relative importance of the above organs was supported by the results of autoradiography; in addition, this demonstrated the high concentration of ^{75}Se in the cell nuclei, where Se may play a fundamental role. Radioselenium from labeled lucerne was found in the milk of a lactating mouse within 4 hr of its being fed. Within 24 hr, ~20% of the Se absorbed by the dam had been transferred to the young mice through the milk. The rapid incorporation into milk of ^{75}Se when fed in this form indicates that the Se complexes normally present in plant material are readily metabolized by the mouse, and that they are normal constituents of milk. To determine whether the ^{75}Se transferred to milk is incorporated in the milk proteins, or is in the soluble (inorganic) fraction, 76 μC of ^{75}Se as selenious acid was injected into the external jugular vein of a lactating ewe and the milk collected during the following 24 hr was fractionated. Activity was measured in the various fractions as follows: fat 0.0, fat membrane protein 2.9, casein 55.4, globulin 6.4, albumin 8.2, and nonprotein Se 27.1%. The major difference was that inorganic ^{75}Se was injected intravenously into the ewe, the Se presumably being metabolized by the mammary gland, whereas the mouse received the ^{75}Se orally as labeled lucerne. Since all of the ^{75}Se appearing in the ewe's milk was derived from inorganic Se circulating in the blood, and the major part (72.9%) appeared in the protein fractions, it is assumed that the activity transferred from the lactating mouse would be in the protein fractions to at least an equal or perhaps a greater extent. (BBB)

17427 A SIMPLE METHOD FOR THE PREPARATION OF ^{32}P-LABELLED ADENOSINE TRIPHOSPHATE OF HIGH SPECIFIC ACTIVITY. I. M. Glynn and J. B. Chappell (Cambridge Univ., Eng.). Biochem. J., 90: 147-9(Jan. 1964).

A method is described for preparing ^{32}P-labeled ATP of high specific activity by an exchange reaction. The method is simple and requires only substrates and enzymes that are available commercially. Hydrolysis of the labeled ATP with heavy meromyosin indicates that 98 to 99% of the ^{32}P is in the γ-phosphate group. (auth)

17428 LOCALIZATION OF PROTEIN-BOUND RADIOACTIVE IODINE IN RAT THYROID GLANDS LABELLED WITH ^{125}I OR ^{131}I. Rosalind Pitt-Rivers, Janet S. F. Niven, and M. R. Young (National Inst. for Medical Research, London). Biochem. J., 90: 205-8(Jan. 1964).

Radioautographic studies of rat thyroid glands were made at different times after labeling with ^{125}I and ^{131}I. Cellular organic radioiodine was demonstrated in the thyroid of an untreated rat after 2-hr labeling with ^{123}I. Cellular organic radioiodine was demonstrated in thyroids of rats pretreated with iodide and labeled with ^{131}I for 10 and 15 min. (auth)

17429 RADIOACTIVITY IN TURDUS MUSICUS, TURDUS MERULA MERULA, AND SCOLOPAX RUSTICOLA. G. Manunta (Università, Sassari, Italy). Boll. Soc. Ital. Biol. Sper., 39: 527-9(May 15, 1963).

Levels of radioactivity were determined in three species of migratory birds (thrush, woodcock, blackbird) that pass Italy between summer and winter habitats in Siberia and Africa. A total of 327 birds was examined between December, 1961 and March, 1962, subsequent to Russian nuclear weapons tests in the Arctic. Specimens digested in hydrochloric acid were counted for α, β, and γ activity. In all of the woodcock and blackbirds examined, radioactivity levels were within normal limits. In bone tissue of four of the 100 thrushes studied, enormously increased levels were detected. Most of this was β activity which could be isolated from bone by standard procedures used for separation of Ca and Sr (no attempt was made to further separate these elements). When the total specific activity was compared with that of a ^{45}Ca standard, the activity for two thrushes was 50 to 60 μC/g Ca and 10 to 15 in the other two birds. These four birds were females collected in December, 1961. The remaining 96 thrushes collected at this time and 127 obtained in March, 1962 showed essentially normal activity. Since these birds weigh about 70 g, of which 6 g is Ca, the four radioactive birds had a total activity of about 300 to 360 μC. (BBB)

17430 CHANGES IN THE SYNOVIAL TISSUES OF THE KNEES OF RABBITS FOLLOWING INTRA-ARTICULAR INJECTION OF THORIUM (THOROTRAST). Charles J. Sutro (Hospital for Joint Diseases, New York). Bull. Hosp. Joint Diseases, 22: 39-42(Apr. 1961).

Pathologic reactions in the tissues of knees of rabbits following intra-articular introduction of colloidal ThO_2 (Thorotrast) were studied. Two ml of Thorotrast were injected into each of the right knees of adult male rabbits; in some the right femoral articular cartilages were irritated 24 hr earlier by inserting a needle into the articular cavity and scratching the anterior surface of the articular cartilage. The animals were killed at intervals of 12, 200, 250, and 270 days following injection of ThO_2. Macroscopic examination showed collections of the foreign material in the thickened, hypertrophied synovial lining of the injected knees. Lymph glands situated on the lumbar portion of the vertebral column were enlarged and contained ThO_2 particles. Microscopic examination of tissues removed 12 days after injection revealed ThO_2 particles engulfed to the greatest extent by the outer layer of cells of the synovium and by the cells lining the intra-articular tendons. All of the right knee specimens removed after a 200-day interval showed hyperplasia of synovial membrane, with formation of villi. The ThO_2 particles were situated in clumps, usually engulfed by giant cells, deep in the subsynovial stratum. The outer or surface cells lining of the synovium contained only sparse amounts of foreign material. Collections of ThO_2 were seen also in subsynovial tissues in the fibers of intra-articular tendons and interstitial loose connective tissue of contiguous muscle fibers. Focal necrosis, calcification, and foreign-body giant cells were encountered in the capsular tissues and in the intra-articular tendon fibers. When articular cartilage was traumatized prior to the injection, ThO_2 was found in the young reparative connective tissue lining the fibrocartilaginous tissue in the surgically produced defects. Normally, cells in the articular cartilage do not act as macrophages; however, some cells in the contiguous synovial lining did take up some of the foreign substance. The results show that ThO_2 was rapidly taken up by the outer layer of synovial cells and transported to the subsynovial layer. A hyperplastic and hypertrophic villous type of synovitis was produced, which simulated to some degree the histologic architecture found in nonspecific villous synovitis in man. The newly formed lining cells covering the fibrocartilaginous connective tissue, which appeared in the defects of the femoral articular cartilage, were able to retain the radioopaque and radioactive foreign material, but the original articular cartilage cells did not retain the foreign particles. (BBB)

17431 USE OF X RAYS IN THE DETECTION OF CALCIUM IN BIOLOGICAL TISSUES AT MICROLEVEL. F. Bohatirchuk (Univ. of Ottawa). Can. Med. Assoc. J., 89: 1171-7(Dec. 7, 1963).

Improved methods for using microradiography to detect small amounts of Ca in tissues are described and illustrated. Soft x rays are generated at voltages ranging from 8 to 12 kv. Since the walls of an ordinary x-ray tube absorb soft rays, a window exit for these rays is made in a special tube for historadiography. This window is covered by a thin Be plate. Microtomy is carried out without previous decalcification, the specimens are embedded in plastic, and sections are cut using a special bone microtome. Historadiography reveals the presence of Ca in tissues but does not show in which particular tissue structure it is localized. Such localization is possible by means of a method called stain historadiography. Stained specimens and historadiographs of the following material are discussed: Ca-containing and Ca-free bone tissues; morphological patterns of Ca distribution during the course of inflammatory and neoplastic bone destruction in humans and animals; Ca distribution in soft tissue during the course of experimental bone atrophy in rabbits; calcification during arthrosoarthritis, ligament, and tendon calcifications; and calcified and growing cartilage in human embryos, young rabbits, rats, guinea pigs, dogs, and cats. The limited magnification of the x-ray image due to granularity of the emulsion is a noticeable defect of historadiography; accordingly, Ca deposits 0.5 to 1 μ in size are the maximum that can be seen in historadiographs at present. (BBB)

17432 THE CONCENTRATION OF RADIOACTIVE STRONTIUM (Sr^{90}) IN HUMAN BONES AND TISSUES IN THE GERMAN FEDERAL REPUBLIC DURING THE YEARS 1958-1962. O. Pribilla (Universitat, Kiel). Deut. Med. Wochschr., 88: 1560-4(Aug. 9, 1963). (In German)

Because of the resumption of atomic bomb tests, studies of ^{90}Sr concentrations in human bones and tissues were initiated in 1958 in order to correlate their rates of ^{90}Sr concentration increase with nutritional status and geographical conditions. Bone concentrations measured in right tibias were expressed in terms of pC ^{90}Sr/g Ca for the age groups 0 to 5 yr, 5 to 20 yr, and over 20 yr. The bone concentrations of ^{90}Sr in stillborn infants was obtained from measurements of the entire skeleton. Most of the samples were obtained from the Schleswig-Holstein area, but some were received from other areas of West Germany. The ^{90}Sr concentrations in the stillborn group were intermediate between these values, and as great as those found in the 5- to 20-yr age group. The amounts of ^{90}Sr in infants were directly proportional to the average monthly concentrations of ^{90}Sr in milk. In bones of newborns the ^{90}Sr concentrations were the same as, and, in a few, were even greater than in the maternal diet. Measurements of 1090 human placentas showed that these were more contaminated with ^{90}Sr than the newborns' bones. (BBB)

17433 EFFECT OF PREDNISONE TREATMENT ON GRANULOCYTE RENEWAL IN THE BLOOD AND ON GRANULOPOIESIS IN NORMAL AND PATHOLOGICAL CONDITIONS. OBSERVATIONS USING GRANULOCYTES LABELED WITH DFP^{32}. C. Sacchetti, P. Boccaccio, S. Lamperi, and A. Ponassi (Universitâ, Genoa). Folia Endocrinol. (Rome), 15: 730-40(Dec. 1962). (In Italian)

Normal subjects were given prednisone orally (30 to 40 mg/day) and studied after 8 to 15 days of treatment; pathological subjects received 30 to 70 mg/day and study was begun when clinical results were evident. Labeling was accomplished either by autotransfusion of labeled granulocytes or by total labeling by intravenous administration of radioactive diisopropylfluorophosphate (^{32}DFP). Total granulocytes in the blood $\times 10^9$, total circulating granulocytes $\times 10^9$, marginal granulocytes (by difference) $\times 10^9$, half life (in hr) of blood granulocytes, rate of renewal of granulocytes $\times 10^9$ in 24 hr, and ratio of renewed to total granulocytes were assessed. Data suggest that prednisone induces neutrophilia with an increase of the total blood granulocyte pool. The leucocytosis development may involve a mechanism related to reduced granulocyte use; formation of neutrophils and their release from bone marrow appears to be unaffected. The mechanism appears related to a decreased extravascular migration of the neutrophil granulocytes and consequent increased susceptibility to infection. The criteria for clinical assessment of granulopoiesis during adrenal steroid treatment are discussed. (BBB)

17434 AGE FACTOR IN THE RESPONSE OF MICE TO THE ADMINISTRATION OF RADIOACTIVE IODINE (I^{131}) AND PROPYLTHIOURACIL (PTU). R. Silberberg and M. Silberberg (Washington Univ., St. Louis). Gerontologia, 8: 140-9(1963).

Mice (C57BL strain) made hypothyroid by injection of 400 μC ^{131}I developed articular changes which were termed athyroid joint disease. These lesions were more readily produced in growing than in young adult animals. Similar joint disease was also observed after feeding propylthiouracil (PTU) to growing mice. Attempts were made to determine whether or not old age modified these effects of thyroid deficiency. The lower incidence of athyroid joint disease in mice of the DBA strain receiving ^{131}I in late adulthood than that seen in mice treated correspondingly during the growth period was noted regardless of whether age at death or post-treatment survival time were used for reference. The difference in the incidence of joint disease in mice given ^{131}I in early or late adulthood, respectively, might be attributed to an age factor as well as to the difference in the post-treatment interval. PTU appeared to be less effective in producing articular lesions than injection of ^{131}I, and no age factor could be demonstrated in the articular effects of PTU under the conditions studied. The evolution of spontaneous osteoarthrosis was not affected by treatment with either ^{131}I or PTU during late adulthood. In the hypophysis the occurrence of thyroidectomy cells subsequent to treatment with ^{131}I or PTU is in accordance with findings obtained previously in C57 mice. In mice receiving ^{131}I at the age of one year, microscopic nodules form and this coincides with the high incidence of hypophyseal tumors observed in C57 mice given ^{131}I at 6 months of age. This strain difference in the reaction of the anterior hypophysis might be secondary to strain differences in thyroid activity. The active thyroids of C57 mice might bind less of the isotope and permit a larger amount of it to reach the hypophysis; there the isotope might exert a tumorigenic effect on the thyrotroph cells which are already stimulated by the absence of thyroid hormone. (BBB)

17435 INFLUENCE OF BERYLLIUM ON TISSUE RESPIRATION. Yu-t'ang Liu. Gigiyena Truda i Prof. Zabolevaniya, No. 9, 41-4(1962).

To solve the problem of the significance of competing interrelationships between divalent cations and Be in the mechanism of the toxic action of Be, its influence on the ability of pulverized rat liver tissue to oxidize ketoglutaric (I), succinic (II), and beta-hydroxybutyric (III) acids was

studied. A pH 7.4 bicarbonate Ringer solution was used as the medium. Be was added in amounts of 0.01M. Tissue respiration was determined in a Warburg apparatus in an atmosphere of O_2 for one hour at 37°C. The addition of Be to a tissue pulp in the absence of the indicated substrates in the medium or in the presence of II and III in it reduced the O_2 consumption to approximately the same degree, i.e., Be inhibited tissue respiration and did not influence the oxidation of II and III. At the same time, Be sharply suppressed the oxidation of I (malonic acid was added to the incubation medium to suppress the succinic dehydrogenase activity). Since the oxidation of II and III is unchanged in the presence of Be, while the oxidation of I is restrained, the hypothesis is advanced that the site of application of the action of Be is the dehydrogenase catalyzing the transfer of H_2 from I to DPN, or an enzyme activated by Mg. (OTS)

17436 THE STABILITY OF I^{131}-INSULIN IN SOLUTION AND ITS USE IN STUDIES OF THE FOREARM UPTAKE OF INSULIN IN MAN. J. S. Cameron (Guy's Hospital, London). Guy's Hosp. Rept., 111: 190-9(1962).

Insulin was iodinated with ^{131}I, and the excess ^{131}I was removed by an Amberlite IRA-400 ion-exchange resin column in the chloride phase. This method gives, using 10 mC thiosulfate-free ^{131}iodide with 6 mg insulin, specific activities of 0.2–0.7 mC ^{131}I/mg protein. This represents much less than 0.1 atom I/molecule of insulin. In undiluted solution (1 mg/ml), insulin was not detectably removed by the column, but more dilute (1:25 and 1:250) solutions were considerably depleted of protein-bound counts. These counts could not be washed off the column by buffer or by dilute protein solutions. Paper electrophoresis showed that over 90% of the radioactivity migrated with insulin. The stability of a 1 mg/ml iodoinsulin solution at 4°C in glycine buffer at pH 9 was studied, to assess how soon before use it need be prepared. Samples of iodoinsulin were kept in the refrigerator for varying times of up to six weeks. Storage for a period as short as 30 or 54 hr resulted in the appearance of large percentages of nontrichloroacetic acid-precipitable material with altered electrophoretic mobility. By use of butanol/acetic acid chromatography on specimens of month-old insulin, the altered material was shown to correspond neither with iodide, monoiodotyrosine, diiodotyrosine, nor with a ninhydrin-staining band of breakdown products. The trichloroacetic acid supernatant contained counts only precipitated very slowly by centrifugation at 3000 rpm for 1 hr, in contrast to the quick precipitation on centrifugation of insulin-bound ^{131}I after trichloroacetic acid treatment. Presumably, therefore, these breakdown products represent medium-sized iodopeptides. Protein, either albumin or plasma protein, added to the insulin solution inhibited the breakdown but because of the intra-arterial studies to be performed, the addition of albumin or other foreign protein was avoided. Three samples, frozen-dried, were found to contain 91, 94, and 95% insulin at the end of 6 weeks. This suggested that insulin was being damaged by ionized water rather than direct irradiation damage. This was supported by the even more rapid disintegration of the insulin on keeping, when the forearm uptake of insulin after intra-arterial injection in humans showed the erroneous results obtained when aged, degraded samples of insulin-^{131}I were used. (BBB)

17437 I^{131} CONCENTRATIONS IN BLOOD, MILK, URINE AND FECES OF DAIRY COWS FOLLOWING A SINGLE DOSE OF RADIO-IODINE. F. W. Lengemann (Cornell Univ., Ithaca, N. Y.). J. Agr. Sci., 61: 375-9 (Nov. 1963).

As part of a program to investigate ways of reducing ^{131}I levels in cows' milk, to reduce the human consumption of radioiodine resulting from fallout, the effect of the level of stable I in the diet upon the concentration of radioiodine in the blood, urine, feces, and milk was determined in dairy cows given a single oral dose of ^{131}KI. Data are also presented on the fractionation of blood and milk radioiodine to provide insight into blood precursors of milk radioiodine. The cows were maintained on diets providing about 3 to 5 or 12 to 16 mg of stable iodine per day. In general, the ^{131}I concentrations in milk and urine tended to parallel the nonprotein-bound ^{131}I of blood. Fecal ^{131}I levels of the low-iodine cows tended to parallel that of the whole blood, whereas it followed the nonbound radioiodine of blood for cows in the higher stable I diet. Compartmental analysis of the concentration curves showed a component with a $T_{\frac{1}{2}}$ of 10 to 22 hr common to both groups of cows. The second component of the curves constructed for the cows on the higher iodine intake had a $T_{\frac{1}{2}}$ of 41 to 58 hr. The second component for the low-iodine cows had a $T_{\frac{1}{2}}$ of 83 to 169 hr for urine, feces, and nonbound radioiodine of blood, and 1200 and 1580 hr, respectively, for the fecal and whole-blood curves. A greater proportion of bound radioiodine was observed in the milk and blood of cows on the low-iodine diet than for the cows on the higher iodine intake. The proportion of bound ^{131}I in blood increased with time, but the bound ^{131}I of milk was relatively constant. It is concluded that there is no advantage in purposely maintaining dairy cows on a low-iodine diet in hopes that their thyroids would trap ^{131}I and in that way significantly reduce the radioiodine secreted into milk. (BBB)

17438 DEPOSITION OF RADIOACTIVE STRONTIUM IN THE DEVELOPING ENAMEL AND DENTIN OF THE RAT. John F. Cleall, Michael G. Buonocore, and Alfredo R. Fonts (Eastman Dental Dispensary, Rochester, N. Y.). J. Dental Res., 42: 1480-9(Nov.-Dec. 1963).

To study the fate of ^{90}Sr in developing enamel and dentin, Long-Evans rats were injected with 2 μC/kg body weight of $^{90}SrCl_2$ (with the contaminant ^{90}Y in equilibrium) intraperitoneally 25 days after birth. Body burden of ^{90}Sr was monitored daily by placing each animal in a whole-body scintillation counter. The relative degree of mineralization was determined by the microdensitometric values and photographic-density values of soft x-ray radiographs, and the relative radioactivity was measured by autoradiographs. In the lower incisor region the enamel showed an irregular small increase in mineralization throughout the period of study, and dentin a more definite increase in mineralization. In the lower incisor region there was a definite drop in radioactivity in the dentin initially, followed by a leveling off of the curve, with a final rapid drop as the hot spot was lost by attrition. In the upper incisor region a similar pattern was found, with little increase in enamel mineralization but dentin first increased gradually in x-ray density and then become fairly constant. The loss of radioactivity in dentin and enamel was similar to that found for these tissues in the lower incisor region. In the upper molars there was an early drop in dentin activity, and the enamel remained at a constant level of radioactivity. In the incisor, as the degree of mineralization increased, the radioactivity fell, with both processes appearing to plateau within a few days of each other. In molars, however, the two plateaus came about 15 days apart. It appears that, once incorporated in the hard tissues, ^{90}Sr was not readily removed. The reduction of radioactivity, observed in autoradiographs and by direct counting, that occurred as the dentin became increasingly mineralized, was only apparent. The results

suggest that physical self-absorption, due to increase in mineralization during development, which masks the radiation, is an important factor in accounting for this reduction. (BBB)

17439 ENHANCEMENT OF THE RENAL EXCRETION OF CESIUM-137 IN RATS TREATED WITH ACETAZOLAMIDE AND RELATED COMPOUNDS. B. V. Rama Sastry and Milton T. Bush (Vanderbilt Univ., Nashville). J. Pharmacol. Exptl. Therap., 143: 30-41(Jan. 1964).

Since Cs and K are closely similar in physicochemical properties and therefore handled similarly physiologically, agents effective in increasing K excretion were tested for ability to increase excretion of ^{137}Cs, a major fallout radionuclide. In rats the renal excretion of ^{137}Cs was shown to be increased by carbonic anhydrase inhibitors (acetazolamide, ethoxzolamide), inhibitors of the H^+ exchange system (maleate) and materials producing hyperchloremic acidosis (ammonium chloride). The results indicate that Cs^+ substitutes for K^+ in the H^+ exchange system. Metalluride blocked the effect of acetazolamide on ^{137}Cs excretion without influence on urine volume and pH. This indicates that acetazolamide increases the urinary excretion of ^{137}Cs by increasing its secretion through the renal tubule in the same manner as it increases excretion of K. Metabolic acidosis nullified the effect of acetazolamide on ^{137}Cs excretion. Rats treated with ammonium chloride and ammonium chloride followed by acetazolamide excreted equal amounts of ^{137}Cs. Repeated doses of acetazolamide did not increase ^{137}Cs excretion, which is similar to the influence of the repeated doses of acetazolamide on K excretion. A relation was noted between the activities of the structural analogs of acetazolamide in their inhibition of carbonic anhydrase and their efficacies for increasing the urinary excretion of ^{137}Cs. Clinical doses of the very active carbonic anhydrase inhibitors, ethoxzolamide and acetazolamide, increased ^{137}Cs excretion for 6 hours. Chlorothiazide is a weak carbonic anhydrase inhibitor, and large doses increased the ^{137}Cs excretion only for the first hour. Clinical doses of hydrochlorothiazide, which do not inhibit carbonic anhydrase, did not increase ^{137}Cs excretion. Maleate increased ^{137}Cs and bicarbonate in urine for 6 hours. Acetazolamide increased ^{137}Cs excretion and thereby decreased the retention in the muscle. Chlorothiazide increased ^{137}Cs excretion during the first hour, but its cumulative effect was to decrease ^{137}Cs excretion, and thereby favor accumulation of higher concentrations of ^{137}Cs in the skeletal muscle. These findings indicate that the excretions of ^{137}Cs and K are controlled by similar renal mechanisms, and the ^{137}Cs excretion can be influenced effectively by pharmacologic agents. (BBB)

17440 THE CONCENTRATION OF RADIOACTIVE IODINE IN THE THYROID LYMPH, THYROID VENOUS BLOOD, AND PERIPHERAL BLOOD OF PRIMATES. P. M. Daniel, Muriel M. Gale, and O. E. Pratt (Maudsley Hospital, London). J. Physiol. (London), 169: 330-8 (Nov. 1963).

Attempts were made to find out to what extent iodinated compounds are present in lymph draining from the thyroid gland of the primate, by using baboons, Papio papio, which were injected with 50 to 200 μC ^{131}I 2 to 7 days before collection of lymph. Radioiodine was released from the thyroid gland of the baboon into the lymphatic vessels which drain the gland, as well as into the thyroid venous blood. A high proportion, 90% or more, of the ^{131}I appeared in the thyroid lymph in organically combined form. The concentration of ^{131}I in the thyroid lymph was very much higher (10 to 100-fold) than that in the thyroid venous blood or in the peripheral blood. The administration of thyroid-stimulating hormone (TSH) raised the concentration of radioactivity in the thyroid lymph as well as in the thyroid venous blood and these separate effects of TSH appeared to be closely related processes. It is known that physical or radiation damage to the thyroid gland may lead to the appearance of iodoprotein in the peripheral blood; however, it was possible to exclude the factor of physical damage by collecting lymph at a distance from the gland. To avoid radiation damage, the doses of ^{131}I used were lower than those generally used in experiments on the release of radioiodine from the thyroid gland. It was shown that if ^{125}I was used instead of ^{131}I, the radiation dose rate to the thyroid gland of a small animal can be reducec by a factor of about 25, and a preliminary study, in which ^{125}I was used in the monkey, suggested that a similar release of radioiodine, in organic form, takes place into the thyroid lymph. It seems unlikely that such a very low radiation dose could damage the thyroid gland. Therefore, it was concluded that the release of iodinated compounds into the lymphatics of the thyroid is a physiological phenomenon and that it is not due to damage to the gland. (BBB)

17441 STUDIES ON THE SELF-DECONTAMINATION OF LIVING OYSTERS USING RADIOISOTOPE LABELED BACTERIA. Tomoko Bito (Inst. of Public Health, Tokyo) and Akira Takase. Koshu Eiselin Kenkyu Hokoku, 12: No. 2, 59-64(June. 1963).

Oysters, which were precontaminated with ^{90}Y-, ^{91}Y-, or ^{203}Hg-labeled E. coli were set in an experimental vessel and rinsed by artificial sea water under several conditions. The results obtained are as follows: the decontaminating effect of sea water on contaminated oysters is proportional to its exchange rate up to 10 times/hr; as the time needed to contaminate oysters with E. coli becomes more prolonged, the self-decontaminating efficiency of oysters is reduced probably because the bacterial contamination is extended into the digestive tract; a larger volume of water in the vessel is unfavorable for the self-decontamination of oysters because of the reduced effectiveness of water exchange; and the most effective salinity is that of the standard artificial sea water (33.5 ‰), and the most effective water temperature ranges from 9 to 22°C. (Public Health Eng. Abstr., 44: No. 3 (Mar. 1964))

17442 STUDIES ON RADIOACTIVE CESIUM. I. THE DISTRIBUTION AND EXCRETION OF ^{137}Cs IN THE RAT. Kaisuke Kameta, Kenshi Katayama, and Tuyoshi Kiyota (Kumamoto Univ., Japan). Kumamoto Med. J., 15: 83-5 (1962).

Two rats weighing about 100 g, 0.05 μC of ^{137}Cs/g body weight was injected subcutaneously. The animals were sacrificed at various intervals ranging from one to 12 days following injection and the organ radioactivities were measured with a scintillation counter. The deposition rate of ^{137}Cs 24 hr after injection was highest in kidney, followed by muscle, spleen, liver, lung, testis, and bone in this decreasing order. Although the concentration decreased rapidly on the 2nd day in kidney, liver, and lung, it increased and reached maximum level in muscle and testis, without marked change in bone and spleen. From the 4th day, there were decreases of the concentration in all organs examined; in the muscle and testis, however, the decrease did not take place as rapidly as in the others. Even on the 12th day, the concentration in testis was nearly half the amount of the first day. The concentration in muscle maintained the highest level among all organs during the whole period of observation and did not decrease to half the amount on the first day. Urinary and fecal excretion rates

of ^{137}Cs showed a maximum on the first day; 12.27% of the given dose was found in the urine and 1.88% in feces. The urinary excretion rate decreased rapidly at earlier periods of the experiment, while the fecal excretion rate decreased more slowly. The total excretion for eight days was 41.26% in urine and 7.59% in feces, amounting to 48.85% in all. (BBB)

17443 STUDIES ON RADIOACTIVE CESIUM. II. EFFECTS OF SOME DRUGS ON THE DISTRIBUTION AND EXCRETION OF Cs^{137} IN THE RAT. Kaisuke Kameta, Kenshi Katayama, and Tuyoshi Kiyota (Kumamoto Univ., Japan). Kumamoto Med. J., 15: 86-9(1962).

The effect of deoxycorticosterone acetate (DOCA) and cortisone, as well as CsCl as a carrier, on the deposition rate and urinary and fecal excretion rates of ^{137}Cs was studied in rats subcutaneously injected with 0.05 μC ^{137}Cs/g body weight. Simultaneously, 1.0 mg of DOCA (as a single dose or daily administration for 3 days), 12.5 mg of cortisone, or 0.1 ml of 10% solution of CsCl was intramuscularly administered to these rats. Radioassays of muscle, testis, liver, and spleen showed that the CsCl and the steroids decreased the deposition of ^{137}Cs. The urinary and fecal excretion rates of ^{137}Cs increased, in general, as the total amount of ^{137}Cs deposited in the organs increased. (BBB)

17444 REGIONAL IRRADIATION OF THE TONGUE BY MEANS OF INTRA-ARTERIAL Au^{198} INJECTION. P. Rossotto, P. Georgacopulo, V. Stancanelli, and S. Guerrieri (Universitá, Sassari, Italy). Minerva Chir., 18: 157-61 (Feb. 28, 1963). (In Italian)

Doses of 5 mC ^{198}Au in either the colloidal form or adsorbed on carbon particles 20 to 40 μ in dia were administered to 10 dogs by the lingual artery with and without ligature of the homolateral vein. Blood samples were taken 1, 15, and 30 min after injection from the homolateral, contralateral, and femoral veins. After 24 hr the animals were sacrificed, the tounges removed, a portion of the liver removed, and a final blood sample taken from the general circulation. With colloidal Au without ligature of the vein, no fixation of radioactivity was noted in the tongue by scintigraphy; however, activity of blood samples from the contralateral lingual and femoral veins indicated considerable distribution of Au after 1 min. Similar results were obtained with colloidal Au with ligature of the effluent vein; in both cases there was rapid, massive fixation of activity in the liver to an approximately equal extent. When Au adsorbed on C particles was injected without ligature of the vein, the blood samples taken from the contralateral lingual and femoral veins had only 20 to 25% of the activity of that from the homolateral vein. Injection of absorbed Au with ligature of the homolateral vein resulted in almost complete localization in the tongue, concentrated at the tip and basal part. Blood samples and activity of the liver also indicated considerable fixation. Tables, autoradiograms, and photomicrographs of histological sections are presented. The fourth method has evident clinical application for irradiation of tumors of the tongue. (BBB)

17445 EFFECT OF COPPER LOADING ON UPTAKE AND EXCRETION OF COPPER-64 BY RAT LIVER. P. J. Scheuer and T. Barka (Mount Sinai Hospital, New York). Nature, 201: 1135-6(Mar. 14, 1964).

The effects of copper loading on the handling of tracer doses of ^{64}Cu by rat liver were investigated. At 1 hr after subcutaneous injection with ^{64}Cu, activity in both bile and liver was nearly twice as high in copper-loaded rats as in normal rats. In each case however, the ratio between bile and liver activity was similar; activity per ml bile was 17.5 and 19.3% of that in 1 g liver in normal and copper-pretreated rats, respectively. The mean concentration of ^{64}Cu in livers at 18 hr represented 22% of the mean concentration at 1 hr, both in normal and copper-pretreated animals. The results suggest that the excretion of ^{64}Cu into bile is directly related to the concentration of ^{64}Cu in the liver, and that the increased concentration of ^{64}Cu in the bile of copper-pretreated rats is a consequence of the higher liver levels. (P.C.H.)

17446 TURNOVER OF RADIOACTIVE STRONTIUM IN NEW-BORN RATS. K. Kostial (Inst. for Medical Research, Zagreb), N. Grunden, and G. E. Harrison. Nature, 201: 1240(Mar. 21, 1964).

Pregnant female rats fed ^{45}Ca and ^{85}Sr were divided into two groups that were given diets containing 0.5 g percent and 1.2 g per cent phosphorus. Offspring were either killed immediately at 14 days of age, or 14 days after litter exchange, whereby newborn rats were fostered by mothers being fed higher diets or vice versa. Litters born and reared by mothers on the higher phosphorus diet had greater $^{85}Sr/^{45}Ca$ ratios than the other group. When litters were exchanged at birth, the young adapted in 14 days to the $^{85}Sr/^{45}Ca$ level appropriate to the foster mother. It was concluded that body stores of P and Ca are extremely labile in the very young. (H.M.G.)

17447 "EXTRACTOR" ANIMALS OF Sr IN MARINE PLANKTON: THE ACANTARI. B. Schreiber and I. Ortalli (Universitâ, Parma, Italy). Nuovo Cimento (1), 1: Suppl. No. 1, 79-85(1963). (In Italian)

Recent studies on the specific scavenging properties of Acantari for Sr were reviewed. The studies showed a positive correlation between the natural concentration of Sr and the percentage of Acantari. Measurement of the total β radioactivity and of the γ spectrum has demonstrated the significant increase of radionuclides in marine plankton following the 1961 Russian nuclear explosions. Studies to examine the accumulation of radionuclides in isolated examples of plankton fauna using photographic emulsions are discussed. (J.S.R.)

17448 HISTOCHEMICAL STUDIES ON THE CONGENITAL SKELETAL ANOMALIES OF RATS DUE TO STRONTIUM SALT. Manzo Nagahama (Osaka City Univ.). Osaka Shiritsu Daigaku Igaku Zasshi, 12: 311-27(Sept. 1963). (In Japanese)

An attempt was made to clarify the histochemical changes of skeletal anomalies due to Sr salt. Female rats (Hybrid) were fed with a routine diet supplemented by 200 mg of $SrCO_3$/100g body weight during pregnancy. Serial sections from the femur of rat fetuses of the 17th to the 21st fetal days were prepared, and comparative studies were performed on glycogen, lipids, Ca salt, nucleic acid, alkaline phosphatase, acid phosphatase, G-Nadi oxidase, and succinic dehydrogenase on materials obtained from corresponding sites. It was found that on the 17th and 18th fetal days, there exist no significant histochemical differences between experimental and control fetuses except for some findings due to underdevelopment of the cartilaginous anlage. On the 19th fetal day, control fetuses showed a marked decrease of disappearance of glycogen, nucleic acid, alkaline phosphatase, and succinic dehydrogenase in the zone of calcifying cartilage on the femur anlage; but experimental ones, which showed a slight curvature in the middle portion of the osseous anlage, demonstrated the above substances moderately persisting in the area which contained hypertrophic cartilage cells occupying about one-third of the cartilaginous anlage. Experiments indicate that hypertrophic cartilage cells show a tendency

to persist in situ, although they are usually not observed on histochemical studies. It is suggested that there is a difference of persistence of hydropic cartilage cells between the concave and convex portions of the cartilaginous anlage. It is considered that such a residual process plays an important role in the formation of the curvature of the cartilaginous anlage owing to Sr salt. (auth)

17449 APPLICATION OF TRITIUM IN BIOCHEMICAL AND BIOLOGICAL INVESTIGATIONS. Emil Nalborczyk (Sakoly Glownej Gospodarstwa Wiejskiego, Warsaw). Postepy Biochem., 8: 95-107(1961). (In Polish)

The measurement of radioactivity of tritium-labeled compounds, their preparation by exchange reactions, chemical synthesis, and biosynthesis are reviewed; 96 references are cited. (BBB)

17450 AUTORADIOGRAPHIC LOCALIZATION OF IODIDE^{125} IN THE THYROID EPITHELIAL CELL. George Andros and Seymour H. Wollman (National Cancer Inst., Bethesda, Md.). Proc. Soc. Exptl. Biol. Med., 115: 775-7 (Mar. 1964).

At short time intervals after injection of iodide-125 to mice, the concentration of inorganic iodide-125 in the thyroid epithelial cells of some follicles was much higher than in the lumen of the follicle or in blood vessels as demonstrated by autoradiographic methods. This finding in both binding and propylthiouracil-blocked thyroid glands suggests that the basal cell membrane is responsible for iodide concentration. The persistence of an autoradiographic image over the follicular cells for at least 5 min after iodide-125 injection suggests that the apical cell membrane exerts some control over the passage of radioiodide from the cell into the follicular lumen. (auth)

17451 SKELETAL CLEARANCE OF Ca^{47} AND Sr^{85} AND SKELETAL BLOOD FLOW IN DOGS. Darrell T. Weinman, Patrick J. Kelly, Charles A. Owen, Jr., and Alan L. Orvis. Proc. Staff Meetings Mayo Clinic, 38: 559-70(Dec. 4, 1963).

Short-term skeletal clearance of ^{47}Ca and ^{85}Sr from the blood in immature and mature dogs is reported, as well as total skeletal blood flow calculated from these data. Carrier-free solutions of $^{47}CaCl_2$ and $^{85}Sr(NO_3)_2$ were diluted with saline to provide ~20 μC/ml and 10 mC of either isotope was injected. Bone specimens were counted in a small-animal whole-body counter which consisted of two 5 × 2 in. NaI(Tl) crystals which were arranged to face each other along a common cylindrical axis. The crystals were partially shielded with 1 in. of Hg and were contained in a special low-background steel box with 6-in. walls. After introduction into the femoral artery the amount of isotope retained by the injected femurs ranged from 38.8 to 55% of the injected dose. Retention of isotope by contralateral femurs and by the humeri ranged from 0.74 to 2.48% of the injected dose. The isotope disappearance curves from plasma from femoral veins were rather flat. Maximum concentration of isotope was reached between 2 and 3 minutes after injection; the concentration then decreased slowly over the remainder of the 10-min sampling period. The mean of the ratios of the maximum plasma activity to the plasma activity to the plasma activity to the plasma activity 10 min after injection was 1.47. Analysis of isotope recovery in the immature dogs showed that on a weight basis, the highest concentration was found in the skeleton and lowest in skin, hair, and muscle; lung tissue had the highest concentration among the soft tissues. Immature dogs retained more ^{85}Sr (mean, 43.1%) in their skeletons than did mature dogs (mean, 27.1%). The slope of the disappearance curve after injection of isotope in the right jugular vein was greater than that after injection into the femoral nutrient artery, the mean ratio of maximum to final plasma activity was 2.65%, compared to the 1.47 after femoral artery injection. Mean arterial concentration, in % of dose per 100 ml plasma, ranged from 3.2 to 8.9 for immature dogs, with a mean of 6.1 for ^{85}Sr and 5.5 for ^{47}Ca. In two mature dogs, the mean arterial concentration of ^{85}Sr was 3.3 and 2.6% of dose per 100 ml plasma (mean, 3.0). Total skeletal blood flow was dependent on the size and age of the dog; therefore, skeletal blood flow per 100 g bone provided a better basis for comparison of the immature and mature animals than did total flow in the whole skeleton. Total skeletal blood flow per 100 g of bone ranged from 6.4 to 9.6 ml/min (mean, 7.7) for immature dogs and was 6.5 to 4.7 ml/min (mean, 5.6) in mature dogs. (BBB)

17452 DISTRIBUTION AND EXCRETION OF RADIOMANGANESE ADMINISTERED TO THE MOUSE. Mikita Kato (Kyoto Univ.). Quart. J. Exptl. Physiol., 48: 355-69(Oct. 1963).

The preparation of ^{52}Mn and its metabolism in the mouse are described. Manganese-52 was produced by the nuclear reaction $^{52}Cr(d,2n)^{52}Mn$. Chromium deposited electrolytically on a Cu plate was prepared for target material (about 200 μ thick). By spectrographic analysis of target Cr, no trace of Mn could be detected, but a trace of Fe was present as an original impurity. The target material was fixed on the water-cooled target holder of Cu and usually used as an external target for bombardment with deuterons of energy of 11.4 Mev and of current about 20 μa from the 44-in. cyclotron of Osaka University. About 0.1 to 0.5 mC of ^{52}Mn was produced from bombardment. Separation of carrier-free $^{52}MnCl_2$ is described. The bombarded target was treated with 6N nitric acid to remove metals except Cr, and a foil of Cr obtained was dissolved in 1 ml concentrated hydrochloric acid. The solution was diluted to 10 ml with distilled water, and poured dropwise on to bromine-saturated 2.5N caustic soda free of Fe (200 ml reagent per 100 mg chromium). The excess bromine was then distilled off completely, and after cooling to room temperature, the solution was filtered with a sintered-glass filter to catch the radiocolloid. The colloid caught on the filter was thoroughly washed with water, eluted five times each with 2 ml hydrochloric acid, and thus 10 ml of carrier-free ^{52}Mn was obtained as $^{52}MnCl_2$; ^{54}Mn was also separated in the carrier-free form through the same procedures. Carrier-free $^{52}MnCl_2$ was dissolved in 0.9% NaCl solution (F solution), and purified $MnCl_2$ was added as carrier to the above solution (C solution). Each solution was injected into a tail vein of an adult male mouse. In both experiments, with F and C solution, the amount of ^{52}Mn found in the various tissues after 24 hr was in decreasing order as follows: kidney, pancreas, liver, intestine, skin, muscle, brain, and blood. As the carrier Mn included in C solution increased, the amount of ^{52}Mn in tissues was generally lowered. Such a carrier-effect was dependent on the concentration of administered carrier. In bone the carrier effect was not apparent. The amount of ^{52}Mn in all the tissues attained a maximum within two hr after administration in all experiments. However, in the experiment with F solution, the elimination of ^{52}Mn from the tissues proceeded more rapidly. The excretion of ^{52}Mn mainly proceeded through the feces, and the rate of excretion reached its peak about 10 hr after administration. Such a rapid excretion probably takes place through a pathway from the intestinal epithelium into the

alimentary canal. The excretion for seven days was 93 and 60% of administered ^{52}Mn for the experiments with F and C solution, respectively. In vitro uptake of ^{52}Mn by various tissues was also measured. (BBB)

17453 AUTORADIOGRAPHIC OBSERVATIONS OF MANGANESE IN ADULT AND EMBRYO MICE. Yutaka Koshida, Mikita Kato, and Tomiyuki Hara (Nara Univ., Japan). Quart. J. Exptl. Physiol., 48: 370-8(Oct. 1963).

Radiomanganese was used for autoradiographic studies on the distribution of ^{52}Mn in adult and embryo mouse tissues. In the adult kidney, ^{52}Mn is accumulated more abundantly in the cortex than in the medulla. On precise examination, ^{52}Mn is detected within the epithelial cells of renal tubules but scarcely in the lumen. In the intestinal villi, ^{52}Mn is found conspicuously in the epithelium and in the mucus adhering to its free surface, which may reflect Mn excretion through intestinal epithelium. It is retained in the exocrine portion of the pancreas but not in the islets of Langerhans, and in the liver it is uniformly distributed over the tissue except the lumens of blood vessels. Retention of ^{52}Mn in the blood is extremely low. In the early embryo ^{52}Mn concentration is less than in placental tissue. In the late embryo, ^{52}Mn accumulation in the bone proceeds in parallel with ossification and ^{52}Mn concentration in kidney is less than in liver, conversely to the case of the adult. (BBB)

17454 IODINE-131 IN POST-MORTEM HUMAN THYROIDS. Frances I. Visalli and Abraham S. Goldin. Radiol. Health Data, 5: No. 3, 145-8(Mar. 1964).

Fifty-seven thyroid samples were made available by three New England hospitals during the period May 14, 1962, through January 10, 1963. Up to the middle of September, ^{131}I was detected in three out of 37 samples (range 47 to 51 pC/g). Positive values for ^{131}I were found in 6 out of 15 post-mortem thyroids from September 15 through October 26 (range 41 to 58 pC/g). From November 4 through January 10, 1963, one positive value (29 pC/g) of ^{131}I was noted among five samples collected. The highest individual thyroid burden noted represented about one-sixth of the RPG of 1.5 rem/yr, and the average of 20 samples after September 15, 1962, represented about one-eighth of the RPG of 0.5 rem/yr. (auth)

17455 STRONTIUM AND CALCIUM REABSORPTION IN RENAL TUBULES OF THE NEWT, TRITURUS PYRRHOGASTER. Ryushi Ichikawa (National Inst. of Radiological Sciences, Chiba City, Japan), Yoshikazu Enomoto, and Fuminori Sakai. Science, 144: 53-4(Apr. 3, 1964).

Reabsorption of Ca in the proximal tubule cannulated in vivo exceeded reabsorption of Sr. The diuretics Diamox and Salyrgan depressed the reabsorption of Ca but not Sr. (auth)

17456 RADIOIODINE METABOLISM IN CHILDREN AND ADULTS AFTER THE INGESTION OF VERY SMALL DOSES. M. A. Van Dilla and M. J. Fulwyler (Los Alamos Scientific Lab., N. Mex.). Science, 144: 178-9(Apr. 10, 1964).

One day after oral ingestion of very small doses (about 0.01 microcurie) of an ^{131}I/^{125}I mixture, the radioiodine content of the thyroid gland was similar in children and adults (about 20% of the dose ingested) as was the biological half life of the iodine (about 90 days). Measurements were made in 15 minutes by means of a whole-body counter with a cylindrical sodium iodide (Tl) crystal, 20 cm in diameter and 10 cm thick. (auth)

17457 UPTAKE, ADSORPTION AND LEACHING OF RADIOSTRONTIUM IN A LYSIMETER EXPERIMENT. Lambert Wiklander (Agricultural Coll. of Sweden, Uppsala). Soil Sci., 97: 168-72(Mar. 1964).

A lysimeter experiment was started in 1957 with an acid soil (pH = 4.5). By liming and K fertilization, four different treatments were arranged. In 1958, 50 μc ^{90}Sr, as $SrCl_2$, was added to the surface soil with the object of studying the translocation of Sr into the underlying soil, the distribution between exchangeable and nonexchangeable forms, the loss of Sr by leaching, and the uptake of Sr by crops during 1959–1962, all as affected by liming and K fertilization. Liming was shown to retard the translocation of Sr from the surface soil to the subsoil in accordance with the theory. In the unlimed soils 32% of the Sr was found below a depth of 15 cm and in the limed soils only 11.0%. Potassium fertilization, on the other hand, somewhat increased the downward movement of Sr. Ten to 12% of Sr retained by the soil was transformed into nonexchangeable form. The loss of Sr by leaching during 1958–1962 was very small (about 1.2% of added Sr) and showed no significant influence of liming, which was due to the same composition of subsoil. Liming, as could be expected, strongly reduced the uptake of Sr by plants, the decrease being 40 to 45%. Four successive crops together took up 4.5 to 9.2% of added Sr. Red clover took up around 7 to 9 times as much as wheat and barley; in one red clover crop on unlimed soil not less than 5.0% of the added Sr was absorbed. Of the Sr taken up by barley 3.9% was found in the seed and 96.1% in the straw. Potassium fertilization decreased the Sr uptake by red clover but not that by barley and not significantly that by wheat. The data from the lysimeter experiments show that, in accordance with the results previously reported, the liming of acid soils contaminated with radioactive Sr has a beneficial effect on the crops by decreasing Sr availability, for it thus reduces its uptake and, consequently, the hazards of radiation. But liming may also have an unfavorable effect, in that it decreases Sr translocation in the soil, thus preserving Sr in the topsoil or in the limed horizon and decreasing its loss by leaching. (auth)

17458 THE ACUTE MAMMALIAN TOXICITY OF RARE EARTH NITRATES AND OXIDES. David W. Bruce, Bernard E. Hietbrink, and Kenneth P. DuBois (Univ. of Chicago). Toxicol. App. Pharmacol., 5: 750-9(Nov. 1963).

To aid in the assessment of health hazards associated with the industrial and medical uses of rare elements, as well as the potential hazard from the chemical toxicity of these metals as products of nuclear fission, their toxicity in rats and mice was studied. Acute toxicity studies were conducted on didymium, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu nitrides and oxides. The LD_{50} values for the rare earth nitrates given intraperitoneally to mice ranged from 225 mg/kg to 480 mg/kg, and for rats from 210 mg/kg to 335 mg/kg. Rats tolerated 1000 mg/kg of the rare earth oxides given orally or intraperitoneally. When these salts of rare earths were administered orally to rats, the LD_{50} values ranged from 2750 mg/kg to 4200 mg/kg. With the exception of the transition elements for which the oral LD_{50} values were greater than 5000 mg/kg, the compounds generally exhibited an increase in toxicity with increasing atomic weight. Intravenous toxicity studies in rats showed that the light lanthanons are highly toxic to rats and an appreciable sex difference in susceptibility was observed. The nitrate salts of Ce, Dy, Nd, and Sm were from 7 to 11 times more toxic to female than to male rats. In contrast, Er nitrate, a member of the heavy lanthanons, did not show the marked sex difference in toxicity to rats. Previous studies with Ce indicated that the ionic form is bound, possibly to plasma proteins, whereas the colloidal form is not bound. Since the solubility of a given concentration of the trivalent lanthanons would tend to decrease in the order of increasing atomic

weight, the tendency of these compounds to precipitate when injected intravenously as aqueous solutions would also increase, and this may account, at least in part, for the difference in distribution and toxicity of the light and heavy lanthanons. (BBB)

17459 SOME CLINICAL OBSERVATIONS ON COWS FOLLOWING THE ADMINISTRATION OF RADIUM^{224} AND CALCIUM^{45}. B. F. Sansom, R. J. Garner, and L. C. West (Inst. for Research on Animal Diseases, Compton, Eng.). Vet. Record, 76: 1-3(Jan. 4, 1964).

In experiments designed to investigate the relative behavior of the alkaline earth elements in bovine metabolism, two pairs of lactating Ayrshire X Redpoll cows received doses of ^{224}Ra and ^{45}Ca. One pair (W258 and W259) received 24 mc ^{224}Ra + 2 mc ^{45}Ca administered intravenously, and the others (U45 and U402) received 2 mc ^{224}Ra + ^{45}Ca intravenously followed after 77 days by 5 mc ^{224}Ra + 5 mc ^{45}Ca orally. Four days after the oral dose, W258 and W259 were both off their feed and badly constipated, and their milk yield was down. They remained ill for 2 days but then showed steady improvement until, a week after the first symptoms, they were eating well and their milk yield was improving. Similar symptoms, but without constipation, were observed after the intravenous dose to these cows. Cows U45 and U402 showed no clinical symptoms after either the intravenous or oral dose. In W258 and W259 the white cell counts made 4 days after oral dosing were within the normal range but on the 7th and 11th days there was a moderate leukopenia in both cows with minimum white cell counts of 2.82 and $1.56 \times 10^3/mm^3$. The differential counts showed this to be due mainly to a fall in the number of neutrophils. By the 18th day the neutrophils had recovered to their normal proportion of about 30%, and only a slight leukopenia was apparent. Seven days after the intravenous dose, a moderate leukopenia was seen in both cows, with white cell counts of 2.2×10^3 and $1.8 \times 10^3/mm^3$, mainly to neutropenia. In this instance recovery was slower, and the values were still very abnormal 14 days after the injection. Both doses also caused slight but progressive thrombocytopenia and anemia. No abnormalities in the blood picture of U45 and U402 were observed at any time after the intravenous or oral doses. Although in man the most sensitive indication of radiation damage is a fall in the numbers of lymphocytes and platelets, the clearest reaction in cows to the feeding or injection of ^{224}Ra and ^{45}Ca was a transient neutropenia. Radiation doses were estimated, and it was shown that the threshold dose to produce changes in the blood picture of cows of sufficient magnitude to be recognized during routine hematological examination lies between 35 and 60 rem. For most mammalian species the threshold dose for significant effects on the hematopoietic system is ~ 100 r of γ radiation. In a large animal this air dose would be roughly equivalent to an absorbed dose of 50 rem. (BBB)

Radiation Effects

Refer also to abstracts 18062, 18103, and 19451.

17460 (AD-260894) PRESERVATION OF FOOD BY LOW-DOSE IONIZING ENERGY. (Quartermaster Research and Engineering Center, Natick, Mass.). Jan. 1961. 171p.

A review is presented of the current status of investigations on the radiation processing of foods. The technical feasibility of this preservation method is well established and the economic feasibility of the method appears promising, particularly in low-dose applications. The current status of development of radiation sources is discussed. Pork has responded best among the meats tested for radiation processing. Sausage, luncheon meats, and chicken demonstrate good potential. Beef appears acceptable at low radiation dose ranges but presents flavor problems at high dosages. The storage life of refrigerated and unrefrigerated marine products is increased by radiation processing. Vegetables are easily damaged by comparatively small doses of radiation. Shredded cabbage treated at 300,000 rad is an excellent product and asparagus, snap beans, lima beans, broccoli, carrots, and corn are promising vegetables for radiation processing. Radiation treatment inhibits sprouting of potatoes and onions. Radiation processing of strawberries, grapes, peaches, tomatoes, and citrus fruits at doses between 200,000 and 800,000 rad affects molds that cause rotting and increases the storage life of these fruits. Radiation processing of cereal grains, cereal products, and military ration components destroys adult insects, larvae, and eggs of insect pests that infest these foods. No radioactivity has been induced in food products by high radiation doses. Extensive studies have shown that radiation processing has no effect on the wholesomeness of foods. The economic feasibility and potentialities of the radiation processing of foods are discussed. (C.H.)

17461 (AED-C-04-13) AED INFORMATION SERVICE. SERIES C: BIBLIOGRAPHIES. SECTION 04: RADIATION EFFECTS ON LIVING TISSUES AND ORGANISMS. W. Stahlhofen, comp. (Max-Planck-Institut für Biophysik, Frankfurt am Main). Jan. 1964. 274p.

One thousand and sixty-nine references are presented to the world literature on radiation effects on living tissues and organisms. An author index is included. (C.H.)

17462 (ANL-6790(p.8-10)) CELL DIVISION IN THE SMALL INTESTINE OF RATS EXPOSED TO CONTINUOUS GAMMA IRRADIATION. Samuel Lesher, Leonard F. Lamerton, R. J. Michael Fry, and George A. Sacher (Argonne National Lab., Ill.).

Preliminary data are presented concerning the effects of continuous γ irradiation on the generation cycle of the crypts of rat small intestine. When the percentage of mitotic figures was plotted against time, curves were obtained for five experimental groups that showed that differences between irradiated and unirradiated rats are quite small. Results were measured at intervals of 12 to 105 days exposure. (C.H.)

17463 (ANL-6790(p.21-5)) AN APPRAISAL OF DIFFERENCES IN ACUTE MORTALITY FROM X- OR GAMMA RADIATION BETWEEN PROTRACTED, SPLIT, AND FRACTIONATED EXPOSURES. Sylvanus A. Tyler and S. Phyllis Stearner (Argonne National Lab., Ill.).

The efficiency of a kinetic model of radiation injury accumulation was appraised as to ability to demonstrate differences in acute mortality from x or γ radiation resulting from protracted, split, and fractionated exposures. Applications of the model in studies of injury accumulation in mice are described. It was concluded that use of the model will greatly facilitate comparisons of mechanisms of acute radiation injury between and within strains and species. (C.H).

17464 (ANL-6790(p.26-30)) THE TOXICITY OF Ra^{226} IN MICE: A PROGRESS REPORT. Miriam P. Finkel, Patricia B. Jinkins, and Birute O. Biskis (Argonne National Lab., Ill.).

Data are summarized on the survival and number of

osteogenic sarcomas and reticular tumors in mice injected 500 days previously with various doses of ^{226}Ra. (C.H.)

17465 (ANL-6790(p.31-48)) TOXICITY AND METABOLISM OF RADIONUCLIDES. IV. PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1962. William P. Norris, Louis S. Lombard, Carl E. Rehfeld, and Thomas W. Speckman (Argonne National Lab., Ill.).

The effect of age on radiosensitivity was investigated in beagles, aged 5 months to 5 yr, after the administration of intravenous injections of ^{137}Cs in the acutely lethal dose range. Data are presented on effects of ^{137}Cs on blood picture and life span. Results are also reported from studies of K metabolism in beagles using ^{42}K and whole-body counting, the effects of ^{60}Co γ radiation on urinary constituents of beagles, and effects of diet and parasitism in dog colonies. An automated data read-out and computation system using a card-fed IBM 1620 computer was developed for analysis of γ spectroscopy data. (C.H.)

17466 (ANL-6790(p.84-6)) SOME COMMENTS CONCERNING THE FEASIBILITY OF DETERMINING THE RADIATION-INDUCED MUTATION RATE FOR SEX-LINKED RECESSIVE LETHALS IN THE MOUSE. Douglas Grahn and Katherine F. Hamilton (Argonne National Lab., Ill.).

The feasibility of determining the radioinduced mutation rate for sex-linked recessive lethals in mice is discussed. Data are included from studies on the reproductive performance in mice that illustrate various problems encountered. (C.H.)

17467 (ANL-6790(p.145-9)) PHOSPHATE ESTERIFICATION AND HYDROLYSIS IN MITOCHONDRIAL PREPARATIONS OF NORMAL AND X-IRRADIATED RAT SPLEEN. John F. Thomson (Argonne National Lab., Ill.).

Results of studies of phosphate esterification and hydrolysis in mitochondrial preparations of normal and irradiated rat spleen showed that four hours after total-body x radiation considerable destruction of lymphoid cells took place. As a result, the preparations of mitochondria isolated from irradiated spleen and thymus contained relatively fewer mitochondria and relatively more lysosomes and microsomes, i.e., there was a diminution of elements capable of esterifying phosphate and an increase in those that hydrolyze phosphate esters. When the conditions of assay were such as to permit phosphorylation to occur rapidly, the level of ATP liable to hydrolysis was kept low, most of it being bound by the phosphorylation mechanism. However, when phosphorylation was impaired, e.g., by restricting the concentration of cytochrome c, the ADP became available to the enzymes with ADPase activity. Since there were relatively larger concentrations of these enzymes in the preparation from irradiated animals, it is not surprising that the P/O ratios were further decreased. Thus as long as the P/O ratios near the theoretical maximum were obtained with control mitochondria, irradiation had no effect. When poor P/O ratios were observed in the controls, still lower ones were observed with irradiated animals because of the relative increase in phosphatase activity. (auth)

17468 (ANL-6790(p.156-60)) SPONTANEOUS NONLETHAL DAMAGE IN A "SMALL" CLONE OF CHINESE HAMSTER CELLS IN CULTURE. Warren K. Sinclair and Carolan H. Wieker (Argonne National Lab., Ill.).

Clones of cells were isolated from a normal population of Chinese hamster lung cells grown in culture that resembled small colonies induced by 1500 r of x radiation. (C.H.)

17469 (ANL-6790(p.161-70)) CHROMOSOME NUMBER AND ABERRATIONS IN "LARGE" AND "SMALL" CLONES OF IRRADIATED CHINESE HAMSTER CELLS IN CULTURE. Warren K. Sinclair and Agnes N. Stroud (Argonne National Lab., Ill.).

Examination of chromosome number and aberrations in irradiated Chinese hamster cells in culture indicated that heteroploidy and aberrations occur quite frequently in cell populations grown out from colonies originally exposed to 1500 r. However, neither the heteroploidy nor the aberration frequency appeared to be correlated with the size of the original colony. The heritable damage manifested as a small colony survivor, which appeared to result in slow growth, poor plating efficiency, and enhanced radiosensitivity, did not seem to be associated with observable chromosome changes in the cell. (auth)

17470 (ANL-6790(p.205-10)) METABOLIC BASES OF THE IMPAIRMENT OF ROOT INITIATION BY IONIZING RADIATION. Solon A. Gordon, Lowell Woodstock, and Bhagwan K. Gaur (Argonne National Lab., Ill.).

Results are reported from studies on the effects of γ radiation on the formation of adventitious roots by excised Coleus leaves. Root formation was delayed by exposure to 15 kr γ radiation. No effect of irradiation on carbohydrate and nitrogen metabolism in the leaves was observed. Results are included from tracer studies of nucleic acid metabolism that indicate that irradiation might inhibit root formation via influence on nucleic acid metabolism. (C.H.)

17471 (ANL-6790(p.228-9)) PROGRESS REPORT: THE EFFECT OF X-RAYS ON THE FORMATION OF FLOWER PRIMORDIA IN XANTHIUM. William Chorney (Argonne National Lab., Ill.).

Preliminary results indicate that low levels of x rays applied to the inducing leaf can alter the flowering response in Xanthium. Flowering was stimulated when the leaf was exposed to x rays prior to the inductive dark period and inhibited when the leaf was exposed during the first post-inductive light period. Several interpretations of these effects of x rays are discussed. (C.H.)

17472 (BNL-7866) RELATIONSHIP BETWEEN CHROMOSOME VOLUME AND RADIATION SENSITIVITY IN PLANT CELLS. Arnold H. Sparrow (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 40p. (CONF-456-1)

From the 18th Annual Symposium on Fundamental Cancer Research and Cellular Radiation Biology, Houston, Tex., Mar. 1964.

New data are reviewed on the comparative radiosensitivity of various plant species. The influence of nuclear volume and chromosome volume on radiosensitivity was investigated. Data are summarized on the effects of ^{60}Co γ radiation or 160- or 250-Kvp x radiation on growth of 50 plant species. An inverse relation was shown between the acute radiation dose necessary to produce lethality or to inhibit growth and the volume estimated to be associated with interphase chromosomes of short meristem cells in a number of species of higher plants. The average absorbed energy per chromosome was calculated to be about 3.7×10^6 ev for a lethal effect, 2.3×10^6 ev for severe growth inhibition, and 1.07×10^6 ev for slight growth inhibition. Much of the apparent difference in sensitivity of the species studied appeared to be spurious and to result from measuring the dose per unit volume or weight of air or tissue. This was true of polyploids compared to diploids. When energy absorption per chromosome at the growth-inhibiting or lethal exposure was calculated for each species, relatively small interspecific variation was found. (C.H.)

17473 (NYO-2565-1) EFFECT OF IONIZING RADIATION ON LYMPHATIC TISSUE. Ailene Herranen (Worces-

ter Foundation for Experimental Biology, Shrewsbury, Mass.). [1963]. Contract AT(30-1)-2565. 14p.

Rabbits were exposed to 650 r whole-body x radiation, and the animals were sacrificed at 1 to 6 hr after exposure. Nitrogen mustard was administered intravenously and the effects on described enzyme systems were measured. Thymus glands from treated and control animals were fractionated and used in tracer studies of RNA and DNA synthesis. Emphasis was placed on studies of lymphocytes from the thymus. Data are presented from analyses of isolated cytoplasmic fractions for DNA content at various times after irradiation, the effects of x radiation on in vitro amino acid incorporation, and the effect of nitrogen mustard on the in vitro incorporation of leucine into thymic cell fractions and on the DNA content of cytoplasmic fractions. (C.H.)

17474 (NYO-10604) EPIDEMIOLOGICAL FOLLOW-UP OF THE NEW JERSEY RADIUM CASES. I. REPORT OF THE MEDICAL STUDY GROUP (JULY 1963). II. RESUMES OF FINDINGS FROM INDIVIDUALS CASE STUDIES. Progress Report to July 1, 1963. (New Jersey. State Dept. of Health. Radium Research Project, West Orange). Contract AT(30-1)-2181. 158p.

Data are presented on the first 150 cases studied by the medical group of the Radium Research Project of the New Jersey State Department of Health. The individuals were known to have body burdens of ^{226}Ra and ^{228}Ra. Twenty of the 150 cases had malignancies. Resumes of findings from individual case studies from 46 cases not previously reported are included. The summaries include a review of the various medical, dental, and roentgenographic findings, as well as compilation and analysis of data obtained from death certificates. A standardized nomenclature of bone lesions observed in roentgenograms for the use of this project is described. The frequency of the type and location of the lesions observed are tabulated. Detailed dental data are tabulated. Additional tabulations of selected medical findings and concomitant body burdens are included. (auth)

17475 (SGAE-BL-2/1964) DIE DOSISWIRKUNGS-FUNKTION IM ERTRAGSGESETZ. (The Dose Effect Function in Yield Law). K. Kaindl and N. Weidinger (Österreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf, Austria). [1963]. 14p.

The effects of dose on the yield law in radioinduced reactions are discussed. The dose-effect relation was determined. Some previous attempts at causal explanation of the yield law for plant growth were arranged under a uniform viewpoint in radiobiology. (M.C.G.)

17476 (SRB-62-6) THE RESPONSES OF LIVING ORGANISMS AND ORGANIC MATERIALS TO DEUTERIUM: A SELECTIVE BIBLIOGRAPHY. Charles M. Pierce, comp. (Lockheed Missiles & Space Co., Sunnyvale, Calif.). Oct. 1962. 19p. (AD-296803)

Selected references on the responses of living organisms and their molecular products to deuterium are presented. The general period of coverage dates from 1957 through 1961. The references are grouped by subject and arranged according to the journal in which they appeared. (auth)

17477 (TID-3098) THE EFFECTS OF RADIATION AND RADIOISOTOPES ON THE LIFE PROCESSES. An Annotated Bibliography. Charlie M. Pierce, comp. Subject Index Prepared by: William E. Bost, Helen L. Ward, and Hugh E. Voress (Division of Technical Information Extension, AEC). Sept. 1963. 1836p.

Issued in two books and an Index.

A total of 11,944 annotated references is presented to report and published literature concerning the effects of radiation on biological systems. Abstracts are included for many references. Author and subject indexes are included. (C.H.)

17478 (TID-20419) THE PHYSICO-CHEMICAL MODIFICATION OF THE MOLECULAR AND BIOLOGICAL EFFECTS OF RADIOACTIVE PHOSPHORUS (P-32) INCORPORATED INTO NUCLEIC ACIDS. Progress Report, May 24, 1963–February 28, 1964. J. G. Van Dyke (New York Univ., New York. School of Medicine). Contract AT)30-1)-3220. 10p.

Progress is reported in preliminary studies on ^{32}P inactivation of phage in Escherichia coli. Results are reported for studies on growth curves of E. coli in low-P medium and the γ-induced molecular breakdown of DNA in vitro. (C.H.)

17479 (UCRL-11191) TRYPTOPHAN SYNTHETASE MUTANTS OF YEAST: ACTION OF A SUPER-SUPPRESSOR IN RELATION TO ALLELIC MAPPING AND COMPLEMENTATION (thesis). Thomas R. Manney (California. Univ., Berkeley. Donner Lab. and California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 8, 1964. Contract W-7405-eng-48. 125p.

Results are reported from a study on tryptophan synthetase mutants of Saccharomyces cerevisiae. A new method was developed for use in the construction of an allelic map for the tryptophan synthetase locus based on the use of x radiation to induce allelic recombination at mitosis in heteroallelic diploids. The map is constructed from the slopes of x-ray dose–frequency curves. (C.H.)

17480 (UR-624) THE EFFECT OF INHALED RADON ON THE SURVIVAL, BODY WEIGHT AND HEMOGRAM OF THE MOUSE FOLLOWING MULTIPLE EXPOSURES. Donald A. Morken (Rochester, N. Y. Univ. Atomic Energy Project). Feb. 7, 1964. Contract W-7401-eng-49. 72p.

Mice exposed to daughter-free Rn atmospheres by inhalation in one or several exposures exhibited a life-span shortening proportional to total accumulated dose. One-half of the lethality injury produced was repaired within a period of two weeks, and the extent of repair was independent of the dose fractionation. The mice also demonstrated a weight loss proportional to total accumulated dose, independent of the dose fractionation. The blood picture evidenced injury proportional to dose fractions when separated by two weeks, and rapid recovery. The blood cell count was permanently depressed by a fixed amount following the first exposure, regardless of dose, and was not further influenced by subsequent doses. (auth)

17481 (FTD-TT-63-1048) THE GENERATION AND INVESTIGATION OF FIELD DOSES FOR IRRADIATION OF EXPERIMENTAL ANIMALS WITH HIGH-ENERGY PROTONS. V. P. Afanas'ev (Afanas'yev), I. B. Keirim-Markus, S. S. Kuznetsova, E. G. Litvinova, I. K. Sokolova, and E. (Ye.) Stukina. Translation of IAEA Preprint No. SM-44/57 from p.1-19 of "Symposium on the Biological Action of Neutron Irradiation, Oct. 7-11, 1963." 24p.

Methods are described that were used to expose dogs to uniform irradiation by the proton beam from an accelerator. Filters at the output of the beam created a sufficiently large field dose of protons, and bilateral irradiation was used to obtain a uniform distribution of tissue doses. Personnel dosimeters and activation detectors were used to measure the tissue dose of protons of 100- to 600-Mev energy within an error of about 10% and to evaluate the dose composition of the effective radiation. (C.H.)

17482 (FTD-TT-63-1049) THE BIOLOGICAL ACTION OF FAST NEUTRONS AND HIGH-ENERGY PROTONS. Yu. I. Moskalev, I. K. Petrovich, and V. N. Strel'tsova. Translation of IAEA Preprint No. SM-44/58 from p.1-33 of "Symposium on the Biological Action of Neutron Irradiation, Oct. 7-11, 1963." 32p.

Results are presented of comparative experiments on the action of fast neutrons and protons on life span, peripheral blood, incidence, and rate of tumor appearance in rats depending on dose and period of observation. White rats were given 14-Mev neutron doses of 8.5, 21, 42.5, 85, 170, and 500 rad or 500-Mev proton doses of 28, 39, 114, 275, 358, 422, 760, 864, and 1008 rad. On the basis of the criterion of life span, neutrons proved to be 1.5 to 1.7 times as effective as protons. Differences in the blood picture and frequency and spectrum of neoplasms in neutron- and proton-irradiated rats are discussed. (H.M.G.)

17483 (JPRS-23983) THE NATURE OF ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF AMINO ACIDS AND PROTEINS SUBJECTED TO THE ACTION OF GAMMA RADIATION AND LIGHT. M. K. Pulatova and O. A. Azizova. Translated from Biofizika, 9: No. 1, 33-9 (1964). 9p. (OTS-64-21960)

The paramagnetic centers of γ-irradiated S-containing amino acids and polypeptides at 77°K represent free radicals with localization of the unpaired electron on a S atom. The hyperfine structure of the EPR spectra of such compounds is determined by the influence of the H nuclei closely situated to the S atom. At room temperature a free radical is formed: $R\text{-}(S \ldots S)^{+}\text{-}R$, common to cystine, cysteine, and glutathione. The illumination of γ-irradiated S-containing amino acids and glutathione at 77°K leads to a considerable reduction of the number of radicals responsible for the cystine EPR signal. The EPR spectrum of γ-irradiated protein at 77°K represents the sum of two signals: singlet and triplet. The latter signal is due to the S-containing amino acid radical. Illumination of γ-irradiated proteins produces an increase in the cystine EPR signal at 77°K. (auth)

17484 (OTS-62-11755/4(p.17-28)) SOME MUTATIONS OBTAINED THROUGH IRRADIATION OF SEED OF SOME SPECIES OF TRITICUM. A. Tavcar. Translated from Arhiv Poljoprivredne Nauke, 15: No. 50, 20-30(1962).

An investigation was made of the possible improvement of certain morphological and physiological properties of wheat by irradiation. Air-dried seed of different genotypes of Triticum were irradiated with different gamma ray doses from a ^{60}Co source. The chromosome aberrations up to the 5th generation were studied after irradiations up to 30,000 r. The following properties of possible useful mutations were studied after 5000, 7500, and 10,000 r irradiations: blade height, spike length, number of spikelets per spike, number of kernels per spike, kernel quality, awn length, vegetation length, winterhardiness, and resistance to Puccinia spp. Many suitable mutations were caused by transgenations. (D.L.C.)

17485 RADIATION-INDUCED BLOOD CHANGES DEMONSTRATED BY FLUORESCENCE. B. Chone (Universität, Heidelberg). Acta Haematol., 30: 8-15(1963). (In German)

Acridine orange vital staining cannot be used as a sensitive cytochemical method for early detection of radiation injury. Cytoplasmic changes, such as variations in the red fluorescence, appear relatively late, and are associated with whole-body radiation exposures of at least 100 to 200 r. For this reason they cannot be included as a direct latent effect of radiation. The zones of cell necrosis or sudden color change of the green fluorescence of the cell nucleus to a yellow hue are apparently related to an unphysiologically high radiation exposure that is not of interest for clinical diagnoses. Even though the color techniques used for fluorescence procedures are simple, they involve rather considerable practical difficulties, because they require a unique balance of color in order to provide a sound basis for evaluation. Studies of structural changes in nucleic acids produced by ionizing radiation show that DNA is a macromolecule very resistant to radiation. After irradiation, the DNA content of nucleated bone marrow cells remains constant, whereas the RNA fraction decreases as the cells mature. The nucleic acid/nucleotide index is from 2.5 to 3.0 for the erythropoietic series, and 1.5 to 1.8 for myeloid cells. When mice are given a lethal radiation dose of 700 r, there is still no detectable change in the nucleic acid pattern after 24 hr. On the other hand, these morphologically intact cells do show a steep drop in the nucleotide fraction that reaches zero after 6 hr, but that shows a tendency to increase by 24 hr. In cells where damage was shown by fragmentation, the nucleic acids decreased by a factor of from 3 to 5. Although it has been postulated that there are two reactive forms of DNA that differ in their radiosensitivity because of their molecular structure, these studies indicate that the radioinduced decomposition of DNA and RNA molecules proceeds through numerous intemediate metabolic steps. These cannot be measured during their early stages by acridine orange fluorescence staining. (BBB)

17486 ACTION OF MUTAGENIC AGENTS ON AUXOTROPHIC STRAINS OF STREPTOMYCES. Miklow Jarai (Chinoin Pharmaceutical and Chemical Works, Budapest). Acta Microbiol. Acad. Sci. Hung., 9: 273-84(1962).

The mutagenic effect on Streptomyces auxotrophs of uv and x irradiation and of some chemical agents was studied. From the observed reverse mutations it was concluded that uv and probably x irradiation have an optimal mutagenic dose. With nine auxotrophic strains it was shown that under the same conditions different gene loci reacted differently to the same mutagenic agent. With uv radiation, mutations occurred most frequently at doses falling within the range of 3500 to 4000 erg/mm^2. With such doses, the average mutation frequency for singly deficient mutants was 0.8×10^{-6}, for doubly deficient mutants 8.4×10^{-6}. An analysis of the number of mutations as compared to the number of survivors in two biochemical mutants (N-4 and N-11) showed that with N-4 the highest number of mutations was obtained at doses of 3500 to 4500 erg/mm^2, namely, 12 to 15 per 10^6 surviving conidia, and with strain N-11, the highest frequency was obtained in the same dose range, namely, three to four mutations per 10^6 surviving conidia. The optimal dose of irradiation corresponds to 90 to 97% lethality. It was shown that, unlike the results with uv irradiation, with x rays no such definite relation existed between optimal dose and frequency of mutations. The highest mutation frequency occurred at doses of 20,000 to 25,000 r, which corresponded to 85 to 91% lethality. Of the chemical substances examined, a definite mutagenic action was exerted by acridine orange, streptomycin, hydroxylamine, phenyl, isocyanate, and 8-quinolinol. The maximum mutagenic frequency for survivors was 41.4×10^{-6} after uv irradiation (biochemical mutant arg 3$^-$; frequency of spontaneous back mutation, 0.041×10^{-6}). With x irradiation the maximum mutagenic frequency was 3.42×10^{-6} (biochemical mutant meth 1$^-$; frequency of spontaneous back mutation, 0.28×10^{-6}). With chemical agents the maximum mutation frequencies for the initial conidia number were as follows: acridine orange, 3.65×10^{-6} (biochemical mutant arg 3$^-$); streptomycin, 2.05×10^{-6} (biochemical mutant arg 3$^-$);

hydroxylamine, 5.81×10^{-6} (biochemical mutant meth 1⁻); phenyl isocyanate, 6.11×10^{-6} (biochemical mutant meth 1⁻); 8-quinolinol, 1.02×10^{-6} (biochemical mutant meth 1⁻). (BBB)

17487 MORPHOLOGICAL AND CYTOLOGICAL OBSERVATIONS ON GAMMA-RAY IRRADIATED RHIZOBIUM LEGUMINOSARUM. Kazimierz Dygdala (Maria Curie-Sklodowska Univ., Lublin). Acta Microbiol. Polon., 12: 237-44(1963).

The bacteria (strains 2 and 308, isolated from peas) in pH 7 buffer were exposed at 10°C for 16 to 17 hr to γ radiation for total doses of 8,100 or 12,600 r. Continuous observations on the development of Rhizobium cells were performed with the use of a dark phase contrast microscope, and five types of impression preparations were prepared for observation of unstained cells, for detecting nucleoids, for demonstration of reducing sites, for demonstrating fat globules, and for fluorescent microscope observations. Janus green B and 2,3,5-tetrazolium chloride were used to detect reducing sites (mitochondria), and lipids were demonstrated with Sudan black B. After continuous irradiation with 8,100 r/17 hr, no differences in the morphology of irradiated as compared with control cells were noted immediately after incubation at 28°C. The duration of lag phase of the irradiated cells was about 5.5 hr. During this time the cells became slightly elongated but did not divide. After 6-hr incubation only one of the examined cells divided, and the newly formed daughter cells grew unidirectionally at one pole. The cells elongated slowly during 7-hr incubation and then developed into bacteroid-like forms in ~12 hr, whereas the transformation of the control cells into bacteroid forms and their division were completed after ~8-hr incubation. The cells of strain 2 behaved similarly to those of 308, and at the higher dosage a similar transformation of rods to bacteroid forms was noted. During the first hour of the growth, chromatin of most cells fused into broad rod-like bodies in the middle of the cell, and after 5 hr the chromatin substance was dispersed. In cultures exposed to 12,600 r, nuclear changes were similar to those in control cells, at least in the initial stage of cultivation. In addition, numerous ghost-like forms were sometimes found. In preparations made from microcolonies after 1 to 3 hr of incubation, the nucleoprotein appeared in the fluorescent microscope as granules or rods with olive-green fluorescence. After 6 to 8 hr of incubation the chromatin bodies disintegrated and the whole cell fluoresced intensely red. The irradiated cells stained with tetrazolium chloride or with Janus green B and contained granules, which were larger and more intensly stained than those of normal cells. They were situated at the margin of the cell. A slightly different pattern of reducing sites was observed in irradiated cells, the light-yellow fluorescence of small granules appearing near the cell membrane. Fat droplets were found in larger quantities in the irradiated cells than in the controls. It is concluded that these cytological aberrations seen in irradiated R. leguminosarum resulted from a disturbance between DNA and RNA synthesis. A block in DNA synthesis and the continued formation of RNA may explain the origin of the intense red fluorescence in enlarged, irradiated cells. (BBB)

17488 FURTHER STUDIES OF GAMMA-IRRADIATED WHEAT AND THEIR RELEVANCE TO USE OF MITOTIC INHIBITION FOR DEVELOPMENTAL STUDIES. Alan H. Haber (Oak Ridge National Lab., Tenn.). Am. J. Botany, 51: 151-9(Feb. 1964).

17489 DEFERRED SEQUELAE INCIDENT TO PELVIC IRRADIATION. Charles J. Smith (Loyola Univ., Chicago). Am. J. Obstet. Gynecol., 88: 91-6(Jan. 1964).

Injury to pelvic tissues as a result of x-ray and/or Ra treatment of uterine carcinoma is described with reference to pathologic findings in six patients. Treatment is designed to deliver between 8,000 and 10,000 r to an arbitrary point in the pelvis. This is ordinarily within the limits of tolerance for the normal tissues encompassed by the treatment area. However, after excessive doses there is an extension of the destructive process to normal tissue, which compromises blood supply and tissue replacement, so that in some instances recovery without permanent damage is impossible. This varies as to dosage and individual susceptibility. For example, brunettes tolerate actinic effect to a greater degree than light-complexioned persons. Chronic ischemia renders the body area more susceptible to infection, trauma, or necrosis. The clinical effects thus produced are mainly indolent ulcers, fistulas, cicatricial obstruction, perforation, osteitis with spontaneous fracture, and general pelvic fibrosis with edema. In the preantibiotic era, death secondary to irradiation was primarily due to sepsis. Pelvic infection due to pyometra, bowel injury, and/or perforation, and debilitation brought on by severe enteritis provided an average mortality rate of about 2%. Recent refinements in radiation measurement have helped eliminate guess-work in the amount of exposure the bladder and bowel receive. However, a certain amount of damage is inevitable and, in the susceptible individual, severe complications may develop years after a satisfactory result is obtained. (BBB)

17490 RADIATION AND HEREDITY. Hermann J. Muller (Indiana Univ., Bloomington). Am. J. Public Health, Suppl., 54: 42-50(Jan. 1964).

Pertinent evidence is surveyed in an attempt to determine whether the radioinduced mutation frequency is really proportional to the total dose of radiation. The nature, amount, and duration of genetic radiation damage are assessed. It is suggested that most genetic damage induced in man could be avoided by artificial storage of germ cells. (BBB)

17491 RADIATION AND CAUSE OF SICKNESS. Leo M. Meyer (South Nassau Communities Hospital, Oceanside, N. Y.). Am. J. Public Health, Suppl., 54: 51-6(Jan. 1964).

The health status of a group of people exposed to accidental fallout in March, 1954, following the detonation of an experimental nuclear device at the Bikini testing site in the Marshall Islands, is reported. In addition to the 23 Japanese fishermen, the largest fallout exposure was sustained by 64 inhabitants on the Island of Rongelap, 105 miles from the detonation site. This gave an estimated dose of 175 r of whole-body γ radiation, contamination of skin sufficient to result in β-ray burns, and slight internal absorption of radioactive materials through inhalation and ingestion. Medical examination of these subjects nine yr after exposure showed slight reductions of all blood cell counts below control levels, but well within the normal range; retardation of growth of male children, especially those exposed at ages 12 to 18 months; complete healing of skin burns, with occasional areas of depigmentation and isolated instances of benign pigmented nevi; complete regrowth of hair in persons suffering epilation; and no instances of leukemia, malignancy, suggestion of increase in the aging process, or decrease in the fertility rate. Whole-body counts of exposed and control subjects were made in 1958 and 1961. Body burdens of various fission products are presented. (BBB)

17492 DISTRIBUTION OF OVA IN THE RAT UTERUS. Robert H. Krehbiel and James C. Plagge (Univ. of Illinois, Chicago). Anat. Record, 143: 239-41(July 1962).

Both ovaries of female rats were exteriorized and, with the remainder of the rat in a protective lead shield, were subjected to 800 r of x rays at 60 days of age. Comparable

irradiation was given to only the left ovary in other animals, and some of these were unilaterally castrated by the removal of the right ovary. In others, unilateral ovariectomy was done without irradiation of the left ovary. Other females were untreated. Distribution of implantation sites was recorded in 86 pregnancies, of which 44 were first pregnancies. Explorations revealed implantations in a total of 123 uterine horns out of a possible 162. The number of ova in a given horn varied from one to 14. The average was 7.8 ova in a single horn in 60 pregnancies produced by untreated ovaries, and 4.2 in a single horn in 63 pregnancies produced by irradiated ovaries. Although irradiation reduced the average number of implanting ova, the distribution patterns in those uteri supplied by irradiated ovaries were not affected. This reduction resulted in 27 uterine horns having only one or two implantation sites. In contrast, owing to irradiation or to unilateral castration, the opposite ovary produced 9 or more implantations in 29 pregnancies. This incidence of either a smaller or larger number of implantations in a single uterine horn is significantly greater (45%) than normal. Distribution was not related to the number of implanting ova. Slightly more than half of the uterine horns had regular spacing. Irregularities were numerous. There was a tendency for ova to implant more frequently in the cervical half of the uterus. It is suggested that distribution is dependent on random scatter at the time implantation is initiated. (BBB)

17493 CYTOTOXIC EFFECTS OF X-RAYS ON NORMAL AND LEUKEMIC LYMPHOCYTES. Robert Schrek and Stefan Stefani (Veterans Administration Hospital, Hines, Ill.). Ann. N. Y. Acad. Sci., 113: 1033-42(Feb. 28, 1964).

In normal rats and after total-body irradiation with 550 r of x rays, the fate in the bone marrow of labeled nucleated and red cells of transfused peripheral blood was observed autoradiographically. Labeled nucleated cells, most of which were lymphocyte-like cells, readily migrated into the marrow parenchyma in normal animals (2 cells/1,000 parenchymal cells/hr). Following irradiation to at least 27 to 51 hr, this migration appeared to be relatively increased. Beyond this time, parenchymal areas were more difficult to be defined as such. Labeled red cells were rarely observed to enter parenchyma despite the presence of nonlabeled erythrocytes within the parenchymal structure after irradiation. The vascular bed following irradiation increased greatly as the parenchyma diminished to a minimum of less than 10% control at 75 hr. Despite these changes in the architecture of the marrow, the average density of labeled cells per area of marrow corresponded to values expected on the assumption of a free-flowing circulation. The technique used at present did not allow us to distinguish, at all times, between a free-flowing circulation through intact sinusoids or through areas in which the sinusoidal wall, as such, was destroyed. (auth)

17494 THE REACTION OF SOME ENZYMES IN STRIATED MUSCLE DURING ACUTE RADIATION SICKNESS. J. Jonek, S. Kosmider, and S. Gajos (Faculté de Médecine, Zabrze, Poland). Ann. Radiol., 7: 57-64(1964). (In French)

By histochemical methods a study was made of the localization and activity of succinic dehydrogenase, DPNH-diaphorase, and ATP-ase in striated muscle of guinea pigs 24 hr, and 4, 6, and 11 days after total irradiation. The results indicate that the activity of the oxidizing enzymes and the ATP-ase increases 24 hr after irradiation and then decreases as radiation sickness develops. In the muscles of controls and irradiated animals two histochemical types of fibril were observed. The smaller fibrils show a strong succinic dehydrogenase and DPNH-diaphorase activity, which is probably due to differences in the metabolism of muscle fibers. The increase in urinary creatine excretion described earlier in the literature in irradiated animals, which is caused by disturbances in resynthesis of phosphocreatine is thought to be due to disturbances in the processes of phosphorylation in the muscles under the influence of x rays. The reduction in the ATP-ase activity of the endothelium of the blood vessels may provoke changes in the transport of substrates from the blood to the sarcoplasma. (auth)

17495 INHIBITION OF THE REJECTION OF RENAL HOMOGRAFTS IN DOGS BY DRUGS. R. Y. Calne (Westminster Medical School, London). Ann. Roy. Coll. Surg. Engl., 32: 281-302(May 1963).

The use of cytostatic drugs and whole-body irradiation to reduce the immunologic response to kidney transplantation is reported. In the absence of such treatments, canine renal transplants usually cease to function 5 to 8 days after operation, although occasionally a transplant will function for 14 days. To prevent rejection of homologous tissue, a very high dose of x rays is necessary. To inhibit renal homograft rejection experimentally, it is necessary to destroy the hematopoietic tissue in the bone marrow. Thus, below 1000-r doses of total-body x irradiation, typical rejection occurs, while above 1300 r rejection is inhibited, but only one of the dogs studied survived more than a few days. The use of thiopurines and other drugs was compared with sublethal whole-body irradiation for effectiveness in prolonging homologous kidney grafts in dogs. The percentages of dogs (104 were studied) surviving beyond 3 months after bilateral renal homografts and treated with x rays, 6-mercaptopurine, nitrogen mustard, cyclophosphamide, Actinomycin D, Actinomycin C were 8, 0, 17, 0, 20, and 25%, respectively. The respective mean survival times with these treatments were 34, 22, 32, 16, 28, and 58 days. When the 104 animals from all groups are considered, only 10% survived beyond 3 months. This marked variability could be attributed to one or a combination of the following: variability of the aggressiveness of immune reaction in different animals; alternative pathways of purine metabolism that can bypass the specific blocks of the purine analogs; variability in absorption and excretion of the drugs; chance relation of histocompatibility factors between random outbred dogs. The significance of these results for human kidney grafting is discussed. Of the various methods of preventing renal homograft rejection discussed, thiopurine drugs appear to be the only agents that have a repeatable effect on adult animals and the lethal effect of irradiation above 1300 r precludes the use of such a dose clinically. (BBB)

17496 RECENT RESULTS OF PERSONAL RESEARCH IN THE FIELD OF SEROLOGY OF RHEUMATOID ARTHRITIS. Heinz Seifert (Saechsisches Serumwerk, Dresden, Ger.). Arch. Interam. Rheumatol., 6: 317-31(Sept. 1963).

The so-called rheumatoid factor is considered in terms of four serum factors termed according to their immunologic capacity and not according to the diseases in which they appear. These factors have the following properties: hemagglutinating factor (HF) agglutinates sensitized sheep cells in the Waaler-Rose reaction; streptococci-agglutinating factor (SF) which agglutinates β-hemolytic streptococci in the L-agglutination reaction; latex particle-agglutinating factor 1 (LF 1); and latex particle-agglutinating factor 2 (LF 2) which separately agglutinate γ-globulin-sensitized

latex particles in the latex fixation test. With each of these four factors, specific antiserums may be obtained from rabbits. The factors, thus, are antigenic. Under the influence of ultrasound (800 kc, 7 w/cm^2) each of the four factors is split into an a (agglutinating) and p (precipitating) fraction. The a fraction of HF agglutinates only sensitized sheep cells (positive Waaler-Rose reaction). The a fraction of SF agglutinates only β-hemolytic streptococci (positive L-agglutination reaction). The a fractions of LF 1 and LF 2 agglutinate only with γ-globulin-treated latex particles (positive latex fixation test). The p fractions are precipitated by their specific antiserums. The prolonged ultrasound destroys the a as well as the p fractions: the a fractions after 4 to 6 hr, the p fractions after 2 to 11 min. The a fractions are more resistant to higher temperatures than the p fractions. The difference is still more marked in the resistance to β and γ rays. The a fractions are destroyed by γ rays after 5000 to 6000 r and the p fractions already after 4 to 17 r. The a fractions also resist β-ray inactivation more than the p fractions. Thus the a fractions were more resistant to ^{60}Co γ radiation than the p fractions by the respective ratios of 854, 554, 1320, and 369 for HF, LF 1, LF 2, and SF, whereas for ^{32}P β radiation these ratios were 2.5, 9.0, 137, and 4. (BBB)

17497 THYROID CANCER IN ADULT FOLLOWING EXTERNAL IRRADIATION. J. H. Morris and Creighton A. Hardin (Univ. of Kansas, Kansas City). Arch. Internal Med., 113: 97-100(Jan. 1964).

Previous reports are reviewed showing that thyroid carcinoma was observed in a significant number of children and adolescents who received x-ray therapy to the thymus in infancy and early childhood. A less significant number of adults developing thyroid carcinomas after irradiation was reported. The present report concerns a case of thyroid carcinoma in a 28-yr-old adult male who received external x ray to the neck at 8 yr of age for what was diagnosed as Hodgkin's disease. His thyroid gland at the time of x-ray therapy was clinically normal and remained so for 13 years before enlargement was noted. Enlargement initially occurred on the side of his neck exposed to the largest dose of irradiation. A total dose of ~2000 r was administered to the cervical region over a 1-yr period. Thyroidectomy was not carried out until 7 yr after discovery of the tumor (originally diagnosed as multinodular goiter). Pathologic examination of the thyroid specimen showed carcinoma with capsular, lymphatic, and venous invasion. The predominant cell type was follicular. Except for the cases reported by the Atomic Bomb Casualty Commission, a search of the literature showed only 12 cases of thyroid carcinomas arising in patients 20 yr of age or older who were irradiated in childhood. (BBB)

17498 ROLE OF ADULT THYMUS IN IMMUNITY AND LYMPHOPOIESIS: OBSERVATIONS IN YOUNG ADULT C3H MICE. Henry A. Azar (Francis Delafield Hospital, New York). Arch. Pathol., 76: 653-8(Dec. 1963).

Young adult C3H mice, thymectomized or splenectomized at 3 months of age, were observed in the nonimmunized state or after repeated subcutaneous injections of human γ-globulin in Freund's adjuvant. Thymectomy resulted in a decrease of ⅓ in the total number of circulating lymphocytes; other leukocytes and hematocrit values were not affected. Thymectomized or splenectomized animals responded to antigen administration with a rise of serum γ-globulin level comparable to that observed in control immunized animals. Thymectomy did not affect significantly the intensity of plasma cell reaction in the spleen, lymph nodes, and Freund's adjuvant granulomata of immunized animals. Thus, the thymus of young adult mice appears to be an important source of circulating lymphocytes or of a factor stimulating lymphocytosis, but does not play alone an appreciable role in the formation of plasma cells in γ-globulin synthesis. At 24 to 48 hr after local x irradiation of the thymic region with a 3000 r tissue dose, a marked decrease was seen in the number of circulating lymphocytes associated with an almost complete disappearance of the lymphocytic population of the thymus. Subsequent repopulation of the thymus was accompanied by a return of the lymphocyte count to preirradiation levels. The magnitude of the postirradiation lymphopenia was comparable to that achieved by thymectomy. X irradiation of the splenic and hepatic areas resulted in panleukopenia, whereas irradiation of the thymic area affected selectively the lymphocytes. Plasma cells and other pyroninophilic lymphoid cells were seen in large number in the thymus and mediastinal lymph nodes of mice irradiated over the thymic region 2 weeks following exposure. This increase in plasma cells in the irradiated field was associated with a rise of serum γ-globulin concentration. These observations indicate an immune response to antigenic by-products of irradiation. The mean weight of the thymus and the ratio of thymic weight to total body weight of female young adult C3H mice were significantly greater than those of males, and there was a significant increase in weight of the thymus following orchidectomy but not after oöphorectomy. Adrenalectomy caused a significant enlargement of the thymus in both sexes, but this was more evident in females. Castration and adrenalectomy did not appreciably affect the weight of the spleen or lymph nodes, nor did they induce changes in serum γ-globulin levels or hematocrit values. (BBB)

17499 THIRD REPORT ON RBE RESEARCH. E. H. Graul, H. Krueger, and H. Hundeshagen (Philipps-Universitat, Marburg an der Lahn, Ger.). Atompraxis, 10: 83-90 (Feb. 1964). (In German)

An analysis was made of the problems underlying the RBE of fast neutrons, with particular emphasis on acute lethality following whole-body irradiation with fast neutrons. Recent studies of this biological parameter in mammals indicate RBE values between 1 and 1.8. (auth)

17500 GROWTH DISTURBANCES IN BONE AFTER X IRRADIATION AND RADIUM IRRADIATION FOR HEMANGIOMATA IN CHILDHOOD. Joachim-Wolfgang Weiss and Anton Gregl (Chirurgische Universitaetsklinik, Göttingen, Ger.). Bruns Beitr. Klin. Chir., 203: 28-39(Aug. 1961). (In German)

A number of injuries from radiation treatment of hemangiomata have been reported in the literature; two additional instances are reported here. The left hand of a 9-month-old child was treated for hemangiomata by exposure to 480 mg-hr of Ra. This was followed by skin necrosis with poor healing, and a permanent flexion of the wrist toward the radial side. At age 13, corrective surgery was required. The wrist was scarred on the thumb side, and the flexion formed almost a right angle. The left underarm on the ulnar side was shortened by 4 cm, the reach was shortened by 3.5 cm, and the ball of the thumb was atrophied by 2 cm. The thumb was shortened by 1.7 cm, and the middle and forefinger were each shortened by 0.5 cm. The skeletal injuries visualized by x ray showed hypoplasia and shortening of the radius. The radial epiphysis was displaced. The distal end of the ulna was raised and bent. The os naviculare was stunted, the os multangulum was completely missing, and there was hypoplasia of metacarpal I. A satisfactory correction was made by partial resection of the ulna

and osteotomy of the radius with 90° traction on the peripheral fragments. The patient reported that the hand became occupationally useful. In the second case, hemangioma on the right hand of an 18-month-old child was exposed to five x-ray treatments of 700 r each. After about seven months radial abduction increased at the right wrist. X ray showed 3.5-cm shortening of the right radius, with the epiphysis turned ~30° toward the radius side. The metaphysis was abnormal and partly sclerotic. The epiphysial trabeculae were coarsened. The wrist bones were hypoplastic. The radius was straightened and the ulna was shortened by osteotomy. (BBB)

17501 EFFECTS OF RADIATION ON THE GROWTH OF EUGLENA CELLS. Saburo Matsuoka (Gifu Prefectural Medical School, Japan). Bull. Inst. Chem. Res., Kyoto Univ., 42: 1-9(Jan. 1964).

Cells were irradiated in distilled water by γ doses of 1 to 3×10^5 r for 30 to 90 min and by neutron units of 4.1×10^7 to 5.4×10^{12} n/cm^2 for 10 to 90 min. No apparent difference was observed between the effects of γ rays and neutrons on the growth of the cells; many cells survived the irradiations. However, some remarkable effects were observed on the growth, death, and albino mutation rates of the irradiated cells, and the degree of these effects was in proportion to the irradiation dose in most cases. Cells immediately after irradiation and their posterity after several generations reach the stationary phase of the culture at 10 to 25% lower cell concentration than the non-irradiated cells. For a lethal dose, LD-50 (11–13) of Euglena cells required about 2 to 3×10^5 r of γ-rays for 60 to 90 min and about 3.6×10^{12} n/cm^2/60 min of neutrons. The rapidly growing cells were generally more radioresistant than the cells of stationary culture. Not immediately after, but several generations from both irradiations, a little difference of cell size was observed between irradiated and non-irradiated cells. Albino mutants of the cells were easily induced by γ and neutron irradiations. (auth)

17502 PROSPECTS FOR VECTOR CONTROL THROUGH STERILIZATION PROCEDURES. Carroll N. Smith (Dept. of Agriculture, Gainesville, Fla). Bull. World Health Organ., 29: Suppl., 99-106(1963).

The use of ionizing radiation and chemical compounds for sterilization of male insects in vector irradiation programs is reviewed. Prospects for vector control through sterilization procedures are based on the successful irradication of the screw-worm fly, Cochliomyia hominivorax, from the island of Curaçao and from the southeastern portion of its range in the United States. The biological condition essential to the success of the method was that males sterilized by the proper dosage of radiation mated normally with normal females, which did not mate again but laid infertile eggs. The success in screw-worm irradication stimulated investigations of the possible application of the method to various other vector species such as Anopheles quadrimaculatus and Aedes egyptii. Other trials failed to control a blow-fly, Lucilia sericata, on Holy Island, off the coast of Great Britain, possibly because of inadequate sterilization or inability of the sterile males to compete successfully with the native males. Related studies with chemosterilants are also described. (BBB)

17503 THE NATURE OF THE RADIATION-INDUCED LESION OF THE ELECTRON TRANSPORT CHAIN OF THYMUS MITOCHONDRIA. J. F. Scaife (Defence Research Chemical Labs., Ottawa). Can. J. Biochem., 42: 431-4 (Mar. 1964).

Mechanisms of the electron transfer reaction and the nature of the soluble factor released by irradiation were studied in thymocyte mitochondria. The effects of oxygen and cyanide on the succinic-2-p-iodophenyl-3-p-nitrophenyl-5-phenylmonotetrazolium chloride (succinic-INT) reductase activity was measured in irradiated thymus homogenates; and succinic dehydrogenase, ubiquinone, and flavin contents were measured in normal and irradiated (800 rads) thymus preparations. No reduction in the flavin content was found showing that dehydrogenase is not lost from thymus mitochondria following irradiation. Chemical properties of the soluble cofactor are cited. It is concluded that the coupling factor is likely a protein which is labilized from the mitochondria by irradiation. (H.M.G.)

17504 THE USE OF CHROMIUM-51 AS A SENSITIVE QUANTITATIVE CRITERION OF EARLY RADIATION DAMAGE TO RAT THYMOCYTES. J. F. Scaife and P. V. Vittorio (Defence Research Chemical Labs., Ottawa). Can. J. Biochem., 42: 503-12(Apr. 1964).

The uptake of ^{51}Cr-chromate by thymocytes in suspension can be used as a sensitive quantitative criterion for the evaluation of early radiation damage to these cells, often under situations where other methods of assessing cell death such as morphological changes do not yield valid results. The development of a radiation lesion is characterized by a reduction in the uptake of ^{51}Cr, which in vitro can be detected one hr following irradiation and with doses as low as 25 rads. By means of this technique thymocytes have been shown to be completely protected by anoxia to doses of up to 150 rads, but at higher levels anoxia affords little protection. No protection of thymocytes could be demonstrated in vivo with S,β-aminoethylisothiuronium bromide hydrobromide (AET) or serotonin at 0.72 mmoles/kg L-cysteine, cysteamine, and serotonin at 1 mM concentration in vitro showed no protection of thymocytes provided they were removed from the cells immediately subsequent to irradiation. (auth)

17505 COMPARISON OF THE EFFECTS OF VISIBLE, ULTRAVIOLET, AND X-RADIATION ON RAT THYMOCYTES. D. K. Myers and Donna DeWolfe-Slade (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Biochem., 42: 529-43(Apr. 1964).

Ultraviolet and x irradiation produce many of the same effects on rat thymocytes in vitro. Exposure of the cells to low doses results in a latent lethal effect, which requires incubation at 37°C for its expression, and in an apparent increase in the rate at which deoxyribonucleoprotein from the cells dissolves to form a gel in 2M NaCl. As the doses are increased, a decrease in the viscosity of the deoxyribonucleoprotein gel, an immediate death and swelling of the cells, and an immediate destruction of nucleotide bases become evident. For either radiation, doses which do not appear to have any immediate effect on the intact cell lead to loss of soluble materials (K ion, ribonucleotides) from the cells after incubation at 37°C for several hours. The amount of uv energy required to produce most of the above effects is nearly 1000 times greater than the amount of x-ray energy required to produce the same effect. Three differences between the effects of uv and x irradiation were observed: uv light was relative inefficient in breaking down the long deoxyribonucleoprotein chains but appeared to destroy H-bonding in the native nucleic acid structure at the same time as it destroyed the nucleotide basis. Moreover, the lethal effects of low doses of uv light on thymus cells require a longer time to develop than do the effects of x irradiation. Thymocytes can also be killed by high intensities of visible light, particularly in the presence of photoreducible dyes. However, visible light produces little

or no latent damage to the cells, nor was any evidence of nucleic acid damage observed. (auth)

17506 THE STABILITY OF HYALURONIDASE ACTIVITY IN IRRADIATED SPERMATOZOA. J. F. Scaife (Defence Research Chemical Labs., Ottawa). Can. J. Biochem., 42: 555-7(Apr. 1964).

The effects of x irradiation on spermatozoal hyaluronidase activity and release were investigated to test the enzyme release theory and to give a measure of fertility other than loss of mobility. Rats and guinea pigs were given whole-body x-ray doses up to 1000 rads with higher doses to the gonads. Cell counts were then made of epididymal spermatozoa and hyaluronidase activity was estimated turbidimetrically. Hyaluronidase activity and release was not significantly affected by doses of x-irradiation, and the permeability of the acrosomal membrane was apparently undamaged. Therefore, it was concluded that the temporary loss of fertility in irradiated males is due to sperm depletion as a result of the destruction of stem cells such as spermatogonia. (H.M.G.)

17507 SCIENTIFIC BASIS FOR THE PROTECTION OF THE NUTRITIVE VALUE OF FOODSTUFFS. K. Halacka and A. Wolf (Purkyne Univ., Brno). Cesk. Hyg., 8: 89-97(Mar. 1963). (In Czech.).

Various commercial methods for preservation of foodstuffs, especially those employing infrared and ionizing radiation, are discussed from the point of view of the necessity of retaining vitamin content. It is proposed that γ irradiation may be used for preservation of potatoes at doses up to 10,000 rad only at certain times of the year when potatoes do not provide the major source of vitamin C. It is suggested that γ irradiation of foodstuffs is limited by the induced changes in taste and texture, but that doses up to 10,000 rad appear to induce acceptable changes. Proteins and lipids may undergo extensive changes, and irradiation products of the latter may be responsible for objectionable flavors. Vitamins B, C, and E are altered by ionizing radiations to an extent similar to those produced by thermal radiation. It is concluded that despite its present drawbacks, ionizing radiations offer a highly optimal potential method for large-scale food preservation. (BBB)

17508 THE EFFECT OF RADIATION ON HEREDITY. Tanka Katsumi (Tokyo Medical and Dental Univ.). Chemotherapia, Special No. 7, 1-6(July 1963).

A review of radiation genetics is presented. (BBB)

17509 PLASMA ALDOLASE ACTIVITY IN RADIUM THERAPY OF CANCER OF THE UTERUS. Sante Proietti (Università, Rome). Clin. Ostet. Ginecol., 64: 594-600 (Oct. 1962). (In Italian)

Changes in plasma aldolase activity in 11 cases of cancer of the uterus (10 cervical and one endometrial adenocarcinoma) and one case of epithelioma of the vulva were studied before, during, and after radiotherapy. Only in two cases was aldolase activity higher than normal. After radium therapy these values increased in 10 cases, with a maximum increase of 4 U/ml from a normal level of 4 to 8 U/ml. In four cases the increase was 3 to 4 U/ml; in six, 0.2 to 1.5 U/ml; in two, there was a decrease of 0.8 and 1 U/ml. The third determination, made a week after the end of therapy, indicated a drop in activity of plasma except in two cases. In five determinations made one month after therapy, a further decrease was noted, except in the one case of epithelioma of the vulva irradiated with a smaller total dose. The average control value of 17% for the increase in aldolase activity found here is less than that found in other studies of malignant tumors, and much less than that found in other diseases. There appears to be a relation between enzymatic activity and tissue necrosis, but equation of this increase and necrosis is oversimplified because of the many exceptions. The gradual elimination of the enzyme by natural routes of excretion and the possibility of an antienzyme, which can block aldolase and thus decrease its activity value below normal, deserve exploration. It is suggested that the value of study of plasma aldolase activity lies not in its diagnostic but in its prognostic significance. (BBB)

17510 ON THE SENSITIVITY OF GERMINATING SPORES OF SCHIZOSACCHAROMYCES POMBE TO X RAYS. E. Ditlevsen and V. Hartelius (Carlsberg Lab., Copenhagen). Compt. Rend. Trav. Lab. Carlsberg, 33: 319-46(1963).

A heterothallic strain of Schizosaccharomyces pombe was used, which when cultivated as a mixture of the two mating types on malt-agar, four-spored asci are formed and liberate their spores. Experiments were carried out in Buerker-Tuerk blood-counting chambers with the spores suspended in wort-gelatin, the chambers receiving a 16,000-r dose of x rays. The viable count (a measure of the resistance to x rays) was defined as the ratio between the number of colonies developed in irradiated and control chambers. Resting spores had a viable count of 5 to 6% and young cells 45 to 50%, showing the cells to be much more resistant to x rays than spores. Attempts were made to follow the development of x-ray resistance of spores during germination into young cells. Development of spores in the chambers was observed microscopically, and, at different germinating stages, chambers with spores were irradiated. During the first 12-hr germination period the resistance of spores dropped from an initial viable count value to 5 to 6% to a very low value, 0.2%; thereafter it increased again, and at 16 to 17 hr regained the initial value. The drop in resistance occurred during the initial stage of germination, the swelling phase. The time when initial resistance was regained coincided with the inception of cytoplasmic growth, and during the later stages of germination the resistance increased roughly in proportion with the increase of cytoplasmic matter. The point of germination at which the individual spore reached minimum resistance was probably only for a short period of its mitotic cycle, presumably during the prometaphase. Many of the lethally damaged spores were able to undergo part of the germination cycle, showing signs of blocked division mechanism (elongated growth). (BBB)

17511 ON THE ABNORMAL GERMINATION OF SPORES OF SCHIZOSACCHAROMYCES POMBE AS A RESULT OF X-RAY IRRADIATION. E. Ditlevsen and V. Hartelius (Carlsberg Lab., Copenhagen). Compt. Rend. Trav. Lab. Carlsberg, 33: 347-59(1963).

It was shown that spores of the fission yeast, S. pombe, which are lethally damaged by x rays are able to germinate and grow to a certain extent. The individual spores were followed in cultures in Buerker-Tuerk chambers until no further development occurred (after two or three days incubation), and their nucleic acid patterns were observed in stained preparations. X-irradiated spores were observed to stop growing at various stages of development, but in a majority of them the cell division mechanism see seemed to be blocked, whereas cytoplasmic growth was able to continue. This caused the appearance of elongated cells, up to 10 times normal length. Elongated cells seemed to produce the same amount of cytoplasm as contained in the progeny of a normal cell which had multiplied during the same time. The block of cell division was not complete; in many apparently undivided cells, mitosis was

in progress, and in one-third of the cases the development proceeded beyond the point of cell division. The cells underwent cell division, although so late that the daughter cells were also elongated. Furthermore, half of the cells divided in an abnormal way by merely forming a cell plate without the daughter cells separating. Also, purely cytoplasmic changes occurred, manifested by abnormal cell shapes in 5% of the cells but ordinarily this did not affect mitotic activity. (BBB)

17512 CLINICAL AND RADIOLOGICAL FINDINGS IN THOROTRAST INJURIES. G. Gehrmann, E. L. Schaefer, and M. Wunder (I Medizinischen Klinik der Medizinischen Klinik der Medizinischen Akademie, Duesseldorf). Deut. Med. Wochschr., 88: 2050-6(Oct. 18, 1963). (In German)

The long physical and biological half life of ^{232}Th and the dense ionization produced by its α particles within the reticuloendothelial tissue in which the colloidal ThO_2 accumulates produce severe radiation injuries. The latent period for appearance of injury in man varies from 11 to 24 yr. Clinical symptoms of Thorotrast injuries have been recently observed in five patients. Skin measurements of radioactivity demonstrated the presence of Thorotrast in liver, spleen, and bone marrow. So many factors affect these measurements that it is not possible to estimate accurately the actual amounts of Thorotrast deposited, but it has been calculated that with a dose of 75 ml the radiation dose to liver is between 700 and 15,000 r over a period of 50 yr. For this same period the total radiation dose in bone marrow may be ~350 r. Of the total dose to the reticuloendothelial system liver receives from 71 to 73%, spleen from 7 to 17%, and bone marrow from 6 to 10%. One characteristic injury frequently observed is the formation of granulomas (thorotrastomas) within the reticuloendothelial system that, depending on their location, can cause tracheal or esophageal stenosis, fistulas, vocal cord paralysis, or cerebral hypoxia. Blood changes, such as thrombocytopenia, slight leucopenia, appearance of large monocytes, and a relative aplastic myelodepressant effect, often appear. Liver tumors have been reported often, but in the patients studied here none were observed. One major late effect is appearance of fibrosis of the supportive tissue of the reticuloendothelial system that is often followed by damage to the tissue parenchyma. Many angiographic studies were performed with Thorotrast during the last war, and many patients with injuries from this agent will probably be observed in the years coming. (BBB)

17513 DISEASES CAUSED BY RADIATIONS. F. P. Cifarelli. Dia Med. (Buenos Aires), 34: 2229-34(Nov. 12, 1962). (In Spanish)

A brief review is presented of radioinduced diseases. (BBB)

17514 THE EFFECT OF RADIOLYTIC PRODUCTS OF WATER ON THE VIABILITY AND MUTABILITY OF THE SPORE A. AUREOFACIENS. S. Yu. Gol'dat (All-Union Research Inst. of Antibiotics, USSR). Dokl. Akad. Nauk SSSR, 154: 457-9(Jan. 11, 1964). (In Russian)

The effect of irradiating the water outside the cell and the water inside the cell was tested on the strain A. aureofaciens LS-B16, which produces aureomycin and tetracycline. In determining the effect of water external to the cell, the dried spores were irradiated with ultraviolet light (2000 ergs/min) or with x rays (36 kr). At the same time, dried spores were suspended in water and irradiated rapidly before the water could penetrate within the spore. An unirradiated suspension of spores served as controls. The spore survival was determined spectrophotometrically. The results showed that the survival of irradiated dry spores was about a factor of five greater than the survival of the irradiated, aqueous suspension of spores. After irradiating spores moistened with an agar solution, the lethal effect was even higher than on irradiating an aqueous suspension of dried spores. The effect of irradiating internal cell water is lethal in this case. A definite lethal effect was also detected on adding irradiated distilled water to the aqueous suspension of spores. The production of antibiotic material was measured in the irradiated spores fed with a moistened agar solution, and it was found that the mutability of various strains with respect to antibiotic production was much greater than in the original strain. Some of the mutants produced no antibiotic, and other mutants showed a significantly greater activity than the initial strain. (TTT)

17515 THE EFFECT OF IONIZING RADIATION ON THE REGENERATION OF BONE TISSUE. S. A. Ivanova (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 154: 982-5 (Feb. 1, 1964). (In Russian)

A total of 110 male white rats 80 to 100 grams in weight was subjected to a subperiosteal resection of the diaphysis of left back limb. The periostium and epiphysis were left behind. A single x-ray dose of 2000 r was delivered to the limb. The animals were separated into seven experimental groups: 1) irradiation and operation on the third day, 2) operation and irradiation on the third day, 3) irradiation and operation on the 8th day, 4) operation and irradiation on the 8th day, 5) irradiation and operation on the 14th day, 6) operation and irradiation on the 14th day, and 7) operation but no irradiation (the control group for the other groups). The growth of the tibia was measured by taking x rays of the limb. No bone growth was observed in groups 1, 3, and 5. The control group showed rapid bone growth. The bone growth of groups 2, 4, and 6 was somewhat slowed down, but proceeded satisfactorily. Osteogenesis is suppressed, if the irradiation is carried out before the operation. If the operation is performed first, however, the regeneration process gives protection against the effects of radiation. The results of cytological and histochemical tests are described. (TTT)

17516 FURTHER STUDIES ON THE EOSINOPHILIC RESPONSE OF RATS INFECTED WITH IRRADIATED TRICHINELLA. Herman Zaiman, Vito Scardino, Paul Berson, and Robert C. Stern (Albert Einstein Medical Coll., New York). Exptl. Parasitol., 14: 1-8(Aug. 1963).

Rats were infected with Trichinella larvae subjected to sterilizing doses (12,000 and 14,000 r) of x radiation. During the course of such infections, which were limited to the intestine, circulating eosinophilia failed to develop in rats infected with larvae subjected to 12,000 r. In another experiment, similar rats infected with larvae exposed to 14,000 r did develop a marked eosinophilic response, in contrast to the previous report. It is not clear why in earlier studies Trichinella irradiated with 12,000 or 16,000 r failed to stimulate an eosinophilia, while similar larvae irradiated with 14,000 r did. One possible explanation offered is that a certain dose of x ray damages eosinophilogenic centers or substances in the parasite while other doses may stimulate such factors. It is also possible that 14,000 r might damage certain structures in such a fashion as to endow them with eosinophilogenic properties. It is concluded that irradiated larvae may or may not stimulate the host's eosinophil response even in the absence of the second generation of parasites. Thus the irradiation technique as used here does not provide an unequivocal answer to the question originally proposed, namely, can or does the intestinal phase of infection with Trichinella initiate the characteristic eosinophilia associated with trichinosis? A different approach to the problem is required. (BBB)

17517 CHANGES OF CHOLINESTERASE IN THE BLOOD AND TISSUES OF RATS SUBJECTED TO IONIZING RADIATION. L. Tominz, L. Andri, and M. Caprotti (Università, Pavia, Italy). Folia Med. (Naples), 46: 189-94(Mar. 1963). (In Italian)

Cholinesterase activity in blood and in liver, kidney, and brain homogenates of rats subjected to sublethal doses of ionizing radiation was studied. Male rats (~250 g) were divided into groups, of which the control group numbered 12. Another group (13 animals) was sacrificed 3 hr after total irradiation (230 kv; 12 ma; filter 1 mm Cu, 1 mm Al; total dose 600 r); a third group was sacrificed 24 hr after total irradiation. Cholinesterase activity was measured by the method of Salvini and Tominz and of Tominz and Cazzaniga; results, expressed in μmoles NaOH consumed in 1 min by 1 ml blood or 1 g tissue, were as follows for controls, 3-hr animals, and 24-hr animals: liver, 3.84 ± 0.33, 4.11 ± 0.19, 4.13 ± 0.16; kidneys, 2.06 ± 0.27, 1.9 ± 0.20, 1.8 ± 0.09; brain, 8.7 ± 1.5, 9.8 ± 0.56, 9.19 ± 1.2; total blood, 0.882 ± 0.164, 0.664 ± 0.031, 0.715 ± 0.024. Thus, significant variations in tissue cholinesterase do not appear on total irradiation; on the other hand total blood activity drops by 23% at the third hr and 20% at the 24th. (BBB)

17518 EXPERIMENTAL STUDIES ON THE SARCOMA FORMATION WITH THORIUM DIOXIDE SOL (THOROTRAST). Masayoshi Ikeda (Kyushu Univ., Fukuoka). Fukuoka Igaku Zasshi, 52: 481-93(June 1961). (In Japanese)

In view of reports of malignant tumors resulting from the use of Thorotrast for arteriography in man, experiments were conducted in rats injected with colloidal ThO_2. Granulomas developed after subcutaneous or intraperitoneal injections of ThO_2, and in 16 to 23% of the rats, depending on the site of injection, sarcomas developed from the granulomas. The highest percentage of malignancy (23%) was noted after subcutaneous injection, and 60% of rats so injected died within one year. (BBB)

17519 RADIATION-INDUCED CRINKLED LEAVES IN JUTE. Rabindra Krishna Basu (Bose Inst., Calcutta). Genetica, 34: 287-95(1963).

Crinkled leaf chimeras appeared regularly, as phenocopies, in the X_1 and P_1 generations of three varieties of Corchorus olitorius L. The S_1 populations were devoid of this abnormality. These plants were also characterized by late flowering and reduction in the number of flowers per plant. The frequency of crinkled leaf chimeras increased with increase in dosages of x rays and ^{32}P beta rays. Inheritance studies revealed no immediate genetic background of these abnormal plants. However, mutations showing crinkled leaves were isolated in some X_3 and P_2 lines and their segregation in later generations was found to be disturbed. Chromosomal abnormalities during meiosis were considered as one of the factors responsible for the disturbed segregation. Crinkled leaf mutations also showed variable manifestation of the mutant characteristic in different years. (auth)

17520 X-RAY INDUCED SEX-LINKED LETHAL AND DETRIMENTAL MUTATIONS AND THEIR EFFECT ON THE VIABILITY OF DROSOPHILA MELANOGASTER. Lawrence D. Friedman (Univ. of Wisconsin, Madison). Genetics, 49: 689-99(Apr. 1964).

Tests were made on 2520 irradiated X chromosomes taken from Drosophila laboratory stocks of Basc and Canton-S strains. Estimates were made on the proportions of lethals and the genetic load of lethals and detrimentals induced. The Basc chromosome is about 50% more responsive to radioinduced lethal mutation than the Canton-S chromosome. It was found that the lethals induced in the + chromosome compared favorably with those tested by other workers, producing an average frequency of about 2.5% per 1000 r. The ratio of the load due to detrimental mutants to that for lethals was 0.125. This is where the load is the product of the frequency and the average effect on viability. This is a considerably lower value than was obtained in earlier experiments but is in general agreement with a recent study by Käfer. Possible reasons for the different results are discussed. (auth)

17521 NONRANDOM DISTRIBUTION OF LETHALS INDUCED BY TRITIATED THYMIDINE IN DROSOPHILA MELANOGASTER. W. D. Kaplan, H. D. Gugler, K. K. Kidd, and V. E. Tinderholt (City of Hope Medical Center, Duarte, Calif.). Genetics, 49: 701-14(Apr. 1964).

Mutations were induced in Drosophila males by tritiated thymidine fed to larvae or injected into adults. Radioautographs of testes of treated males demonstrated a correlation between the occurrence of mutations and the presence of labeled sperm bundles. In addition to the presence of sex-linked recessive lethals, dominant lethals were also measureable. Mapping of the induced sex-linked recessive lethals disclosed a nonrandom distribution which differed from reported distributions of mutations induced by x rays and gamma rays. Distribution of mutations induced by H^3T appears to reflect the varying frequency with which thymine bases occur along the length of the Drosophila X chromosome. (auth)

17522 GENETIC EFFECTS OF DEUTERIUM OXIDE IN DROSOPHILA MELANOGASTER. Ann M. Hughes, Philip E. Hildreth, and Gweneth Carson Becker (Univ. of California, Berkeley). Genetics, 49: 715-24(Apr. 1964). (UCRL-10976)

Deuterium oxide was incorporated into the culture medium at concentrations of 10 or 20%. These concentrations had no apparent effect on recessive lethal production or nondisjunction, nor was mitotic or meiotic crossing over between X chromosomes in the female influenced by 20% D_2O. The induction of sterility and crossing over between the X and the short arm of the Y were strongly influenced by 20% D_2O. (auth)

17523 ON RADIATION-INDUCED DISORDERS OF CELL METABOLISM. Hanns Langendorff (Heiligenberg Institut, Heiligenberg/Baden, Ger.). Hippokrates, 34: 9-14(Jan. 15, 1963). (In German)

At the levels radiation is generally used, radiation effects are considered to result from energy absorption, followed by radiochemical reactions that affect biochemical reaction chains, and, finally, the appearance of the radiation effect. Two important factors are that a radiation effect can be evoked by only a small amount of radiation, and there is a certain delay time or latency period before appearance of the effect. Lethal injury to an adult human can result from as little as 6×10^4 ergs, an energy that is 10^{-5} as great as is produced by the body in one second. The latency time does not seem to be directly related to the magnitude of the dose, suggesting that only a small amount of energy is needed to initiate events that lead to a radiation effect. Differences in radiation sensitivity vary considerably between organs and tissues, and is often measured in terms of chromosomal damage. Embryonal or glandular tissue, bone marrow, and other rapidly growing tissues are especially sensitive to radiation, but lymphocytes are not so susceptible. Irradiation of various tumors has shown that their radiation sensitivity cannot always be judged by their mitotic rate. Many of them, in spite of a very low rate of mitoses, are extremely sensitive to radia-

tion. Clumping and fragmentation of the chromosomal substance, often associated with bridge formation between chromosomes, suggests a destructive radiation effect on genetic material. Differences in DNA concentration are induced by radiation. Evidence suggests that the sensitivity of DNA biosynthesis to radiation is not due to effects on its biosynthesis rate, but to the enzyme that catalyzes its formation. The enzyme structure is not destroyed, but its activity is markedly enhanced. Only at very high radiation dosages is there evidence of marked enzyme inactivation. Many radiation effects observed in medical practice may be related to radiation effects on enzymes. (BBB)

17524 ON THE USE OF IONIZING RADIATION FOR CONTROL OF MICROORGANISMS ON FRESH FRUIT AND VEGETABLES. J. P. Skou (Atomic Energy Commission Research Establishment, Riso, Roskilde, Denmark). Horticultura, 16: 143-9(Aug. 1962). (In Danish)

Experiments are reported on the effects of ^{60}Co γ radiation on the microflora on apples, potatoes, tomatoes, asparagus, and other fruits and vegetables. Increasing doses of radiation were found to induce increasing damage to plant materials in such a way that wounds have difficulty in healing, the material becomes softer, and cell permeability increases. For this reason it is not feasible to use high doses of irradiation on fresh fruits and vegetables other than those which will provide first-class market products. Radiopasteurizing doses reduce the number of microorganisms, and may change the flora so that relatively resistant organisms (for example, various yeasts and especially Aureobasidium pullulans or black yeast) may survive to further attack the damaged plant tissues. In natural populations of microorganisms there is wide spectrum of radiosensitivity, not only between the genera, but also within the single genus, owing to differences in development. Under the conditions studied, the results of radiosensitivity tests fit the formula: $(N/N_0) = (D/D_0)^{-a}$ better than that of Lea (N_0 being the number of organisms in the control, N the number after doses D, and D_0 the highest dose at which the number is still N_0, and a is a nondimensional gradient). Fresh fruit and vegetables could be divided into two groups according to the effect on them of irradiation. A decrease in deterioration with increasing doses was noted in the first group, containing acidic fruits such as strawberries, raspberries, and citrus fruits. These fruits allow only a limited flora to grow owing to their low pH. Climatic conditions prevailing at harvesting of soft-fruits greatly influenced the storage life in both irradiated and control samples. The second group was characterized by increasing deterioration with increasing doses, except for sterilizing doses. In potatoes and carrots increasing rot may set in after sprout-inhibiting doses when these vegetables are bruised or stored under nonoptimal conditions of temperature and humidity. (BBB)

17525 NEUTRON EFFECTS ON LIVING THINGS. Intern. At. Energy Agency Bull., 6: No. 2, 26-30(Apr. 1964).

Biological effects of neutrons and the methodology for comparing absorption of different types of radiation in tissues are discussed. Papers presented at an IAEA symposium at BNL October 1963, on biological effects of neutrons, are summarized. (R.E.U.)

17526 AEC PROGRAM ON LOW-DOSE IRRADIATION PROCESSING OF FOOD. Kevin G. Shea (Division of Isotopes Development, AEC). Isotopes Radiation Technol., 1: No. 2, 181-8(Winter 1963-64).

Studies of the radiation pasteurization of food are reviewed. Progress made in the technology necessary to extend the refrigerated shelf life of fruits and marine products by irradiation is described. A commercial process is outlined for several food items. The refrigerated shelf life of some seafoods was extended as much as five-fold. Irradiation sources are described. Wholesomeness and acceptability are discussed. (M.C.G.)

17527 RADIATION RESISTANCE AMONG BACTERIA. Margaret J. Thornley (Low Temperature Research Station, Cambridge, Eng.). J. Appl. Bacteriol., 26: 334-45(Dec. 1963).

The nature of bacterial inactivation by radiation is considered, and the sequence of events in radiation damage to living organisms is discussed. It is stressed that the initial physical and chemical changes induced by radiation are extremely rapid, whereas subsequent mutations and death require processes of cell metabolism that take a comparatively long time before they become manifest. A survey of relative radioresistance of various species shows that doses required for 90% inactivation of different bacteria vary by a factor of more than 50-fold. Properties which may be connected with radiation resistance are discussed. Electron micrographs showing the structure of Micrococcus radiodurans are illustrated. (BBB)

17528 A STUDY OF NEUROLOGICAL AND MORPHOLOGICAL CHANGES FOLLOWING X IRRADIATION OF SPINAL CORDS OF NEONATAL RATS. Shirley Ann Gilmore (Univ. of Arkansas, Little Rock). J. Arkansas Med. Soc., 59: 375(Mar. 1963).

An experiment was designed to evaluate neurological alterations induced by x irradiation of spinal cords of neonatal rats of the Sprague-Dawley strain. Rats, one to 21 days of age, received 4430 r (single dose) of 50-kvp x rays to a 50 mm^2 area of the back overlaying the caudal portion of the spinal cord. These animals were observed for several months with neurologic examinations being given first at daily and later at weekly intervals. The principal alteration noted in those irradiated when 1 to 5 days of age was bilateral paralysis of the hindlimbs. Those irradiated at 10 or 15 days showed markedly less severe alterations; those irradiated at 21 days manifested no neurologic changes. Not only the severity of neurologic changes decreased with increased age at time of irradiation but also the number showing neurologic changes decreased with increasing age. Conversely, the time between irradiation and the onset of neurologic changes increased with increasing age. Since it was found that animals irradiated at 1 to 5 days of age showed neurologic changes at 9 to 11 days postirradiation, an experiment was designed to study morphologic changes occurring during this 9 to 11-day period. Three-day-old rats were irradiated, as described above, and killed at intervals up to 11 days postirradiation. The spinal cords submitted to microscopic examination revealed a marked decrease in neuroglial cells within and limited to the irradiated area. Myelin stains showed amyelination or hypomyelination confined to the irradiated area. On the other hand, no extensive alterations were noted in neurons. (BBB)

17529 IMMUNOLOGICAL FACTORS IN HOMOGENEOUS BONE TRANSPLANTATION. IV. THE EFFECT OF VARIOUS METHODS OF PREPARATION AND IRRADIATION ON ANTIGENICITY. Dennis B. Brooks, Kingsbury G. Heiple, Charles H. Herndon, and Arnold E. Powell (Univ. Hospitals of Cleveland). J. Bone Joint Surg., 45A: 1617-26(Dec. 1963).

The effect of certain clinically employed methods of storage, sterilization, and chemical extraction on the antigenicity of the bone homograft was studied. The test animals were mice of the C_3Heb/Fej and $C_{57}Bl/6JAX$ strains, in which the isogenicity of the strains was demonstrated by successfully interchanging skin grafts between strain

members. The acceleration of skin-graft rejection was employed to assess the effect of the various methods of preparation on the antigenicity of bone homografts. Acceleration was considered to have occurred when the mean skin-graft-rejection time for an experimental homograft series was significantly different from the mean rejection time of the skin-alone controls, but not significantly different from the mean rejection time of the fresh-homograft series. Implantation of a fresh-bone homograft was associated with a definite acceleration of the skin-graft-rejection time, and with frozen-dried-bone homografts the mean rejection times of the test skin graft were not significantly different from the mean rejection times in the skin-alone controls. The mean rejection time with frozen homografts did not differ from that of the skin-alone controls. Some bone samples were submitted to high-energy electron irradiation (to doses of 2 Mrep), in addition to freezing. The mean rejection time of the animals receiving the frozen-irradiated bone homografts could not be differentiated from that of either the skin-alone controls or the fresh homograft animals; therefore, the implantation of homografts irradiated after freezing appeared to have an indeterminate effect upon mean skin-graft-rejection time. Also, the effect of the frozen dried-irradiated homograft could not be differentiated from that of the skin-alone controls or the fresh homograft. Implantation of deproteinized autoclaved homografts also appeared to have an indeterminate effect on skin-graft rejection. It was concluded that fresh-bone homografts have antigens in common with skin. Freezing and freeze-drying bone homografts appeared to inactivate the antigens bone has in common with skin. Decalcification, deproteinization, and deproteinization and freezing of the bone homograft appeared to leave sufficient common antigens intact to result in acceleration of skin rejection. The indeterminate results were obtained with frozen-irradiated, frozen-dried-irradiated, and deproteinized-autoclaved bone may have been due to inadequate sample size. The problems of method and interpretation are discussed. The nature of bone antigens and their ultimate importance to the effectiveness of a bone homograft remain unsettled. (BBB)

17530 THE RISK OF DIAGNOSTIC RADIOLOGY. R. J. Hoy (A.M.P. Building, Canberra, Australia). J. Coll. Radiol. Australasia, 7: 227-32(Oct. 1963).

Evidence relating to the injurious somatic and genetic effects of medical and dental irradiation is reviewed. Seven investigations have failed to demonstrate an association between childhood malignancies and leukemia and prenatal radiation, and two appear to have demonstrated an association. Both have demonstrated that the total effect is very small. The number of cases of leukemia and malignancy thus caused are estimated to be 3 to 5 cases per year in Australia. The evidence on leukemia is inconclusive, but at worst there are less than two chances in a million of a particular person becoming leukemic as a result of diagnostic radiation during his lifetime. After consideration of genetic effects, it is concluded that an estimated increase of 1.5% of the mutation-doubling dose of radiation continued at that rate year after year will raise the number of achondroplastics in Australia from the present of about 1,000 to about 1,015 in about four generations. It is suggested that 85% of the population genetic dose is associated with about half a dozen examinations where the gonads are in the direct beam, notably lumbar spine, pelvis, hip examinations, pyelography, and obstetric examinations. Examinations of chest, all extremities, barium meal, skull, and sinuses together make up 15%, i.e., 2 to 3 mrem/yr. Dose reduction can be achieved by various technical factors such as fast films and screens, filtration, kv selection, and gonad protection, and image intensification. (BBB)

17531 EFFECTS OF X IRRADIATION ON OPERANT BEHAVIOR IN THE RAT. Leonard E. Jarrard (Washington and Lee Univ., Lexington, Va.). J. Comp. Physiol. Psychol., 56: 608-11(June 1963).

Attempts were made to confirm the results of Russian investigators who have recently reported changes in behavior, both learned and unlearned, with extremely small amounts of irradiation. To check these reported findings, the effects of a wide range of doses of x irradiation on operant behavior were studied. Two groups of 24 rats each were trained to press a bar, one for food and one to avoid shock. After considerable training, each group was divided into four equated subgroups that were exposed to 0, 100, 300, and 500 r. Performance in the shock-avoidance situation did not change after irradiation but performance for food was affected. In a food-consumption study using the same x-irradiation levels as the operant behavior study, significant changes in food consumption were obtained at lower radiation levels than those needed to cause significant changes in bar pressing for food. Thus subjects receiving 100 r ate less than those in the control group on the first day after irradiation, while those receiving 300 to 500 r differed significantly from the control group for five days. In the number of bar presses, those rats receiving 100 r did not differ significantly from controls on any of the seven days after irradiation. Irradiation with 300 r resulted in a significant decrease in number of bar presses for food on the first day after irradiation but by the second day the rats had recovered enough that they did not differ from the control group. Those animals receiving 500 r differed significantly from the control group for four days postirradiation. Since there were no changes in the performance to avoid shock, but there were changes in the performance of bar pressing for food, it seems that the present changes in behavior following irradiation may be due to changes in motivation. The simple measure of amount of food eaten was a more sensitive indicator of radiation exposure than the more complex behavioral measures. Not only were significant decreases in food consumption found at a lower radiation level (100 r), but doses of 300 and 500 r resulted in significant changes in food consumption that persisted longer than changes in operant behavior. Thus, the most sensitive behavioral measure of radiation exposure was the one that involved the least learning. It is concluded, relating these results to those reported by the Russian investigators, that there is little support for changes in behavior following small amounts of irradiation, thus, little support for the belief that the central nervous system is extremely sensitive to radiation. (BBB)

17532 RESPONSE OF X-IRRADIATED AND CRYPTORCHID TESTES TO ENDOGENOUS GONADOTROPHINS IN PARABIOTIC RATS. D. C. Johnson (Kansas Univ., Kansas City) and E. Witschi. J. Endocrinol., 27: 193-9 (Nov. 1963).

Immature male rats were: exposed to x rays, made cryptorchid, or subjected to a combination of the two, and placed in parabiosis with castrated males. Pairs were autopsied at various intervals up to 46 weeks and effects upon gonads and accessory sex organs evaluated. The experiments were undertaken to determine the endocrine activity, and the possibility of tumor formation, in irradiated and cryptorchid testes continually stimulated

by high levels of endogenous gonadotropin. X-ray dose levels used were: a total of 600 r in two doses, 600 r in one dose, or 1000 r in one dose. Attempts using 3000 r resulted in severe burns. Following irradiation, testicular weight was always below that of controls. Two doses of 300 r resulted in damage to the germinal elements and little regeneration was seen after 7 weeks. When 600 r was given in a single dose, similar results were obtained, with some return of spermatogenesis after 19 weeks and androgen production. On the other hand, almost no regeneration was seen in the seminal tubules following irradiation with 1000 r. Androgen production, however, continued above that in normal single males, with stimulation of the accessory organs. It was evident that at these doses interstitial testicular tissue survived irradiation and was able to respond to increased luteinizing hormone from the castrated partner. Results in the 2nd group (cryptorchid male and castrated male) demonstrated that intra-abdominal testes can produce increased amounts of androgen when constantly stimulated by endogenous gonadotrophins from a castrated partner. In the 3rd group (x-irradiated cryptorchid male and castrated male) the intact partner received 1000 r on the 28th day and then was rendered cryptorchid at parabiosis on the 30th day. The irradiated intra-abdominal testes did not regain any germinal elements within 18 weeks; the tubules were shrunken and contained only sustentacular cells. Thus, unlike the situation with x irradiation or cryptorchidism alone, the stress of the combination of effects renders the testes unable to respond to the gonadotrophins of the castrated partner. The results indicate that irradiated testes are capable of responding to endogenous gonadotrophins; even at doses as high as 1000 r to 28-day-old males, interstitial cells secrete sufficient androgen to produce greatly enlarged accessory sex organs. Various degrees of regeneration in germinal elements followed two doses of 300 r, and was not correlated with androgen output. (BBB)

17533 PERIVASCULAR EXTRAVASATION OF THOROTRAST (REPORT OF A CASE WITH 14-YEAR FOLLOW-UP). William S. Rinker and Sailendra Sinha (Germantown Hospital, Philadelphia). J. Germantown Hosp. (Philadelphia), 4: 88-96(Aug. 1963).

Clinical and pathologic findings are described in a fatal case resulting from a lesion in the neck produced by extravasation of colloidal ThO_2, used for cerebral angiography. The case illustrates the sequence of events following the formation of a hard, fixed neck mass as the normal tissues are replaced by dense contracting connective tissue and concentration of this process in the lymph nodes with their subsequent fibrosis; the gradual interference with the function of the 9th, 10th, and 12th cranial nerves along with the sympathetic chain as they traverse the cervical area becoming demyelinized and degenerating into complete fibrosis leading to disturbances in deglutition, vocal cord paralysis, atrophy of the tongue and Horner's syndrome; the steady impairment of the blood supply not only to the structures in the neck but also to areas fed by the carotid arteries such as the brain; and, during all this time, the interference in the function of the muscles of the neck causing restricted motion, discomfort, and further disruption of the swallowing function. This case clearly demonstrated the latent period with a steady increase in severity of symptoms after this time. There was no evidence of malignant change found in any tissues of this case including the thyroid gland, and it is suggested that the carcinogenic action of ThO_2 in man has not yet been demonstrated. As to treatment of these cases, the best results have been obtained by a carefully done radical neck resection to remove all the granulomatous tissue and therefore the radiation effects of the ThO_2. (BBB)

17534 COMPARISON OF SELECTED ACTINOBACILLUS SPECIES WITH A HEMOLYTIC VARIETY OF ACTINOBACILLUS FROM IRRADIATED SWINE. Psyche W. Wetmore, John F. Thiel, Yaye F. Herman, and James R. Harr (Walter Reed Army Medical Center, Washington, D. C.). J. Infect. Diseases, 114: 186-94(Nov.-Dec. 1963).

In studies on the effects of irradiation in swine, microorganisms with colonial characteristics of the genus Actinobacillus were isolated from the blood and/or synovial fluid of inflamed hocks of four adult pigs and one piglet. These cultures were hemolytic, and otherwise varied little physiologically from available strains of Actinobacillus lignieresii and A. equuli. Therefore, attempts were made to further characterize these organisms isolated from swine blood and synovial fluid, and to examine their biological similarities to strains of A. equuli, A. lignieresii, and A. mallei. Four of the isolates were from the blood of adult swine killed by an atomic explosion and the fifth was from a lethally irradiated young pig. These isolates were serologically related to strains of A. equuli and A. lignieresii; the latter species comprised a serologically heterogeneous group with intergrading antigenic properties. Although A. equuli and A. lignieresii are classified in the literature as separate species on the basis of the ability of the former but not the latter to produce nitrite from nitrate, this separate speciation could not be confirmed, and it is proposed that the taxonomic designation equuli be discontinued. Also, A. Mallei strains were very different from other Actinobacillus strains, and it is suggested that the species A. mallei be designated as Pseudomonas mallei. In virulence studies, the actinobacilli isolated from irradiated swine did not produce evident disease when 1 billion cells were injected intraperitoneally in guinea pigs, but 500 million cells injected into mice caused 35% mortality in 24 hr. (BBB)

17535 IRRADIATION PROCTITIS. James F. Bishop. J. Iowa State Med. Soc., 53: 135-7(Mar. 1963).

The incidence, pathology, symptoms, and treatment of radiation injury of the distal large bowel resulting from Ra or x-ray therapy of uterine cervical cancer are surveyed, and observations on 25 cases of irradiation proctitis are presented. In this series of patients the incidence of significant rectal injury following irradiation of cervical cancer was ~10%. Each of the 25 women had symptoms sufficiently distressing so that the radiologist, gynecologist, or family doctor felt specialized care was needed. The histopathology of irradiation proctitis presented varying degrees of damage to the rectal epithelium. With severe injury, outright cell death occurred, whereas with lesser involvement, there were irregular areas of ulceration and a definite lag in the healing process. There were varying degrees of fibrosis and thickening of collagen and muscle fibers, which often resulted in loss of elasticity of the rectal wall, along with fixation of the mucosa to the underlying scar tissue and muscle. Gross pathology presented a variable picture. A few patients experienced first symptoms 3 to 4 months after the completion of treatment, but the largest group noticed the onset of difficulties from 6 to 9 months after treatment. Others had an even longer interval of a year or two, and three had no symptoms until between three and five years later. The symptoms varied with the severity of the involvement. Where rectal bleeding and tenesmus occurred and bowel damage was not exces-

sive, oral steroids were of great value. Prednisone was used, beginning with 5 mg every 6 hr and increasing or decreasing in dosage in accordance with the response. As improvement occurred, the minimum maintenance dosage was sought, and when it was found it sometimes had to be continued for months. One patient needed 5 mg daily or on alternate days for 2 years, to prevent recurrence of bleeding. Rectal instillation of various therapeutic substances has been recommended but steroid suppositories, warm oil, solutions of hydrocortizone, local anesthetics, and corn starch, all as retention medications, were tried and abandoned. Oral prednisone, along with nonnarcotic pain relief, and warm Sitz baths, seemed most effective. In some cases, however, the damage was so great that surgical relief was necessary. When the lesion was limited to the rectum, sigmoidal colostomy was the procedure of choice. (BBB)

17536 SOME CURRENT CONCEPTS IN RADIATION MICROBIOLOGY. Gerald A. Trautenberg (Rutgers Univ., Newark, N. J.). J. Newark Beth Israel Hosp., 13: 293-307 (Oct. 1962).

Possible mechanisms of radiation energy absorption in cells, as well as morphologic, physiologic, and genetic variations induced by ionizing radiation in these cells, are discussed. The target theory as applied to microorganisms, that a cellular entity (or target) contains one and only one sensitive region which upon exposure will be affected by a single radiation particle to produce a single effect, is examined. It is concluded that the existence of a sensitive site in bacteria may be plausible; however, the arguments for its existence are not so easily supported. Also considered is the concept of indirect action, which differs from that of direct action under the target theory in that the molecule studied does not absorb the energy but receives this indirectly by transfer from another molecule. Factors modifying the effects of ionizing radiations on microorganisms are described including: time-dose rate factor; population concentration; comparative radiosensitivity; effect of atmosphere; drying and temperature; effects of pH; nutrition; age; effects of chemicals; and protection, adaptation, and recovery. Various factors which can modify the effects of ionizing radiations on microorganisms, and thus afford some control over protective measures, are discussed, and chemical protectors considered. Applied radiation microbiology, especially radiation processing of foods, drugs, and other materials is reviewed, showing that among investigators engaged in this field there exists a rather wide variance of opinions as to the future application of ionizing radiation. The problem of radioresistant microbial strains occurring in foods is discussed, and 46 references are cited. (BBB)

17537 EFFECTS OF 200-kv RADIATION AND COBALT-60 RADIATION ON THE ORAL MUCOSA, GINGIVA, AND ALVEOLAR BONE OF EXPERIMENTAL ANIMALS. Irving Meyer (Tufts Univ., Boston), Gerald Shklar, and John Turner. J. Oral Surg. Anesthesia Hosp. Dental Serv., 21: 147-53(Mar. 1963).

Single doses of x and γ rays were applied to the oral tissues of rats in an attempt to confirm the previously observed bone-sparing effect of ^{60}Co radiation. The doses used were 1020, 1530, and 2040 r with both kinds of radiation. The gingiva of 200-kv x-irradiated animals (2040 r) showed a decided pathologic condition. The epithelium was thin and atrophic, with degenerative alterations in the connective tissue and a decrease in vascularity. Ulceration and severe gingival inflammation, with the formation of gingival abscesses were noted in occasional animals. The gingiva in the ^{60}Co-radiation group (2040 r) was essentially normal, with only a tendency to inflammatory infiltration of the underlying connective tissue. Occasional animals exhibited considerable gingival inflammation, but abscess formation was not observed. In the 200-kv x radiation animals (2040 r) the interdental septal bone showed granularity and irregularity in staining. Degenerative changes, including pyknosis, were noted in the osteocytes. Osteoid was absent and reduction in the number of osteoblasts was observed. The adjacent periodontal membrane showed a reduction in the number of fibroblasts, and a reduction in vascularity of connective tissue. The endosteal marrow spaces were increased. In the ^{60}Co radiation animals (2040 r) the bone was essentially normal, but occasional animals showed some reduction in the number of osteoblasts and fibroblasts in the adjacent periodontal membrane. Degenerative nuclear changes were infrequent. Lingual mucosa of these animals showed no changes from the normal histological appearance from 2040 r administered by either 200-kv or ^{60}Co radiation. (BBB)

17538 EFFECTS OF X IRRADIATION ON ADRENAL FUNCTION IN RATS. Sumio Shima and Michio Matsuba (National Inst. of Radiological Sciences, Chiba, Japan). J. Physiol. Soc. Japan, 25: 377-82(Aug. 1963). (In Japanese)

Most previous reports on the early effects of x irradiation on the weight, ascorbic acid, and cholesterol content of the adrenals show that the acute radiation syndrome has much in common with the response to nonspecific stresses resulting in adrenal stimulation. The present findings, on the contrary, indicate that the corticosteroid content of the blood, collected by direct cannulation of the adrenal vein of the rat, decreases about 30 min after whole-body or local (adrenal-only-exposed) x irradiation at doses of 800 to 2000 r. After local irradiation, the adrenal of the unirradiated side maintains the same corticosteroid secretion as that of intact normal and sham-operated rat in spite of a drastic decrease in the irradiated side. Administration of ACTH to the irradiated rats did not raise the corticosterone secretion to the normal level. In rats stressed by immobilization, steroid secretion is also decreased by whole-body or local x irradiation, even in each case of exposure to adrenal only, exposure to head only, and exposure to the whole body with shielding adrenal region. It is suggested that x radiation has a dual action: systemic suppression of the adrenals, presumably via the hypothalamus-pituitary axis; and local inactivation of adrenal function itself. (BBB)

17539 SUPERPREGNANCY FOLLOWING PRE-FERTILIZATION X IRRADIATION OF THE RAT. E. W. Hahn and R. L. Morales (Univ. of Rochester, N. Y.). J. Reprod. Fertility, 7: 73-8(Feb. 1964).

The early and late effects of a single whole-body exposure of 400-r x rays on reproduction were studied in rats exposed during various stages of the estrus cycle prior to mating. The early effects in females that mated during the first expected estrus after irradiation seemed to involve superovulation, the greatest response occurring in females irradiated during metestrus (M) or early diestrus (M + 1). Implantation rates were increased in all groups of females except those which mated half a day after irradiation (M + 3B). Average litter size was highest in females irradiated during metestrus or early diestrus. Those females irradiated during late diestrus (M + 3 and M + 3A) had litters which were comparable to control size, whereas the litters were more or less completely resorbed in females that mated half a day after irradiation. Though the numbers of corpora lutea were still increased up to at

least 17½ days after exposure, the number of implantations and of 20-day fetuses, was comparable to control values in females that mated after the first expected estrus (late effects). Fetuses, under both early and late effects, were normal in size and development. The most significant observation is the induction of superpregnancies in rats by exposure to x irradiation, particularly in M and (M + 1) females. These findings are unexpected from data on fertilization before and after x irradiation and subsequent embryonic mortality in the mouse, and the fact that 500 r is just sublethal in the rat. These differences between the mouse and rat are probably due to the fact that the mouse ovary is more sensitive than the rat ovary to ionizing radiation. (BBB)

17540 EXPERIMENTAL RADIATION DAMAGE OF THE RETINA. Setsuko Shimizu (Nagoya Univ., Japan). Kitakanto Igaku, 12: 237-49(July 1962). (In Japanese)

Previous histopathologic observations of irradiated retinas are reported, and a table is provided of types of damage occurring at various dose levels. New data are provided on the effect of x radiation upon the retina of adult rabbits and mice investigated histopathologically and histochemically. One eye or the head of the animals was exposed to x rays at doses ranging from 1,000 to 10,000 r. Observations were made of histopathologic changes 24 hr after irradiation. Degeneration of the visual cell layer was observed in both rabbits and mice to which doses of 3,000 to 4,000 r were administered, and the outer layer was damaged by 6,000 r. The histochemical changes in the rabbit retina revealed that intensity of the periodic acid-Schiff (PAS) reaction was increased by doses of 2,000 r or more in the visual cell layer compared with control material. The PAS reaction in the outer layer was increased by 4,000 r. The alkaline phosphatase reaction was increased in the damaged retina by doses of 2,000 r or more and its changes resembled those observed for the PAS reaction of the rabbit retina. The acid phosphatase reaction was increased in the outer layer 5 days after irradiation by the 6,000 r. The methyl green-pyronin reaction and succinic dehydrogenase activity were markedly decreased with the progress of retinal damage induced by the x radiation. (BBB)

17541 THE IMPORTANCE OF THE QUANTITATIVE ALTERATIONS OF THE EXTRACELLULAR SPACE IN THE WATER-IMBALANCES OF THE EXPERIMENTAL "INTESTINAL X-RAY DEATH." Zoltan Zseboek and Gyoezo Petranyi. Magy. Radiol., 16: 1-8(Feb. 1964). (In Hungarian)

The importance of the gastrointestinal x-ray syndrome was examined in rats, using the inulin method combined with the ligation of the hilum of the kidney. Giving 1300 r, after 24, 48 and 72 hr the alterations of the active extracellular space of the whole organism and the single organs and those of the inulin permeability of the gastrointestinal tract were examined. Two phases of the reaction are distinguished in the disturbance of the water equilibrium, concomitant with the gastrointestinal x-ray syndrome. In the first phase, the extracellular space of the organs increases except in the cerebral and the muscle tissues. In the second phase, considerable diminution of the extracellular space of the whole organism and the examined organs was found, persisting until the animal's death, except in the spleen. In the small intestine, however, the diminution of the water space was of lesser degree and was observed in the late phase. The results of the experiments are discussed on the basis of the data of the literature. (auth)

17542 RADIATION AND PREGNANCY. Thomas B. Lebherz and Friedrich Ellinger (U. S. Naval Hospital, Bethesda, Md.). Med. Ann. District Columbia, 31: 67-70(Feb. 1962).

Radiosensitivity of the human embryo is discussed in relation to the hazards of diagnostic radiologic procedures performed on women in early pregnancy. Case reports of accidental, inadvertent, or therapeutically indicated exposures suggest the fetal somatic effect to be a potential reality and that the degree and type of malformation bear a direct relation to total dose and week of gestation. Doses received by the fetal and maternal gonads during various radiologic procedures are compared. Although these doses alone appear to involve but little or no risk to the embryo, they do appear significant from the point of view of the induction of genetic effects, especially since the hazard lies in the repetition of exposures. As an example a case report is cited in which various procedures carried out in a 20-yr period resulted in a cumulative dose of 30 r. (BBB)

17543 THE TECHNIQUE OF INTRAVITAL HISTOCYTOLOGICAL INVESTIGATION OF RADIATION INJURIES OF THE SKIN WITH THE AID OF CONTACT FLUORESCENCE MICROSCOPY. I. Ya. Barskii and M. L. Gershanovich (Inst. of Oncology, Academy of Medical Sciences, USSR). Med. Radiol., 9: No. 2, 29-36(Feb. 1964). (In Russian)

A method is proposed for intravital histocytological study of radiation injuries of the skin by means of contact fluorescence microscopy. With the aid of the latter the method enables the injured areas of the skin to be examined in experimental and clinical conditions without any additional traumatization or biopsy. A description of the contact fluorescence microscope and the technique of treating the injured area of the skin with a solution of acridine orange are given. The results of preliminary observations characterizing histocytological shifts in the irradiated skin of patients are included. (auth)

17544 THE TEMPERATURE REACTION OF MONKEYS TO RADIATION. N. A. Volokhova. Med. Radiol., 9: No. 2, 75-80(Feb. 1964). (In Russian)

Systematic investigations were carried out on the rectal and skin temperature of monkeys irradiated in doses of 15,000, 10,000, 6,500, and 350 r. The total irradiation was effected in a uniform gamma-field with a dose capacity of 336 r/min. The data derived were confronted with the results of experiments on dogs irradiated in doses of 350, 15,000, and 30,000 r in similar conditions. It was concluded that no relation exists between the nature of the temperature reaction of monkeys and dogs and the dose of radiation: monkeys develop a profound hypothermia in response to massive irradiation, whereas in dogs there occurs a phasic alteration of hyperthermia and hypothermia. (auth)

17545 CLASSIFICATION OF RADIATION SICKNESS. G. D. Baisogolov and A. K. Gus'kova. Med. Radiol., 9: No. 2, 100-3(Feb. 1964). (In Russian)

A scheme is given for radiation sickness classification that covers various forms of clinical developed and local damage in acute, subacute, and chronic sickness. (R.V.J.)

17546 BLOOD PRESSURE AND PULSE RATE DURING IRRADIATION OF THE HYPOPHYSIS WITH RADIOACTIVE MATERIALS. F. Scheminzsky and H. Schroeksnadel (Universität, Innsbruck, Austria). Muench. Med. Wochschr., 104: 493-7(Mar. 16, 1962). (In German)

Systolic and diastolic blood pressures and pulse rates were measured in 15 resting healthy students, ages 20 to 25 yr, at intervals during 45-min time periods before and after, as well as during a 1-hr exposure to a 25-μC Ra source directed toward the hypophyseal region. Corre-

sponding measurements were also made in 12 other similar subjects who were exposed to a 968-μC Ra source under the same conditions. The radiation consisted of γ photons only, and the dose rate for the stronger source was 12.5×10^{-3} r/hr. Exposure of the subjects to nonradioactive dummy sources was used as a blind control procedure. Blood pressure and pulse rate measurements were made with minimal movements and disturbance of the subjects. In the group that was exposed to the 25-μC source the average systolic pressures varied between 121 and 124 mm Hg, and the diastolic pressure varied from ~77 to 79 mm Hg. The average pulse rate decreased from ~76 to 67 over the experimental period. The pressures and rates measured in conjunction with exposure to the nonradioactive source were almost identical with these values and with those obtained from the group exposed to the 968-μC Ra source. In this group the average systolic blood pressure varied between 122 and 127 mm Hg, and the diastolic pressures were found to be from 77 to 80 mm Hg. The pulse rates decreased from ~80 to 67 from the beginning to the end of the experiment. The results indicated that there was no measurable increase in blood pressure caused by exposure to radioactive sources of this magnitude, which are sometimes used for irradiation of the hypophyseal region. (BBB)

17547 A PEDIATRICIAN LOOKS AT THE HAZARDS OF DIAGNOSTIC RADIATION. Theodore D. Scurletis (North Carolina State Board of Health, Raleigh). N. Carolina Med. J., 23: 202-4(May 1962).

The extent and hazards of excessive radiation doses in pediatric procedures are discussed. Futile uses of x rays are enumerated, such as to locate a foreign body when the history reveals that the body is of a plastic substance that cannot possibly be visualized by x ray, to evaluate a possible orthopedic injury when a careful history and physical examination yield no evidence to support the presence of a fracture, or for suspected injury merely because compensation or liability is involved. Charts are provided showing total and gonad doses received by infants and children during various diagnostic x-ray techniques. Measures are recommended for lowering pediatric exposure. (BBB)

17548 EXPERIMENTAL SCLEROSIS OF THE AORTA AND X IRRADIATION. Nagahiro Hirano (Nagasaki Univ., Japan). Nagasaki Igakkai Zasshi, 37: 49-58(Apr. 1962). (In Japanese)

The effects of whole-body irradiation on the normal and sclerotic aortas were studied experimentally in 110 rabbits which were divided into six groups as follows: group A irradiated with an acute single exposure of 250 r in air; group B irradiated once a week with 16 r; group C fed a high-fat diet containing 5 g fat per day (lanolin and cottonseed oil 2:1) and injected subcutaneously with 0.2 ml of 0.1% adrenaline every other day; group D fed as in group C and irradiated as in group A; group E fed as in group C and irradiated as in group B; group F (control) fed with bean-curd refuse as in groups A and B but not irradiated. Rabbits of each group were sacrificed after 5, 10, 20, 40, or 60 weeks. The average blood cholesterol level in the high-fat diet groups (C,D,E) remained higher than the concontrols through the whole experiment; however, no correlation between cholesterol level and grade of sclerotic change was found. Histologic findings in the aorta apparently due to irradiation were disarrangement of muscle cells, vertical streaking of the muscle fibers, fragmentation and splitting of the elastic fibers, and medial proliferation and calcification. These changes were more severe after an acute single irradiation (Groups A and D) than after chronic irradiation (Groups B and E). No correlation between the total accumulated x-ray doses and the grade of histologic change was demonstrable. The accelerated production of aortic sclerosis due to x irradiation was noted in the early period (5 to 30 weeks) of this experiment. This effect of x irradiation was more marked after acute single irradiation with 250 r than after repeated irradiation with 16 r. (BBB)

17549 ELECTRON MICROSCOPIC STUDY OF EARLY CHANGES INDUCED BY FAST-NEUTRON IRRADIATION OF RABBIT LENS AND CILIARY BODY. Tsugihiko Tokunaga (Nagasaki Univ.), and E. F. Riley. Nagasaki Igakkai Zasshi, 37: 221-9(Aug. 1962). (In Japanese)

The eyes of young albino rabbits were irradiated with fast neutrons, at doses of ~400 rad to the right and 500 rad to the left eye. The lens (epithelial cells from the intermediate zone and equator, and young lens fibers in the equatorial cortex) and ciliary epithelial cells were investigated by electron microscopy, after removal of the eyeballs 24, 48 hr, and 4 days later, in addition, to clinical observations. Almost no clinically detectable change was seen. Mitochondria and endoplasmic reticulum of lens epithelial cells were enlarged and vacuolated, beginning 24 hr after irradiation. The enlargement of these organelles decreased by the fourth day. There was little change in the Golgi apparatus. Nucleoli of lens epithelium and young lens fibers appeared fragmented and aggregated beginning 48 hr after neutron exposure. The change was more severe on the fourth day. Multiple vesicles were seen in the cytoplasm of the ciliary epithelium 24 and 48 hr after irradiation, and formation of abnormal gaps in intercellular space between nonpigmented and pigmented epithelium was seen four days after irradiation. Fragmentation and aggregation of nucleoli of lens epithelial cells and young lens fibers were the most conspicuous changes, and appeared to represent the fast-neutron injury in the nuclei of these cells which may later lead to formation of cataract. (BBB)

17550 VARIATIONS IN BODY TEMPERATURE FOLLOWING WHOLE-BODY X-RAY RADIATION. Goro Inada, Tatsuro Kamio, Mineko Ishizaki, and Osamu Yohsimi (Nagoya City Univ., Japan). Nagoya Med. J., 8: 45-53 (Oct. 1962).

A study of the relation between variations in body temperature and x irradiation was undertaken. Female mice of 20-g body weight were exposed to a single x-ray dose of 500 to 2000 r over the entire body, and variations in rectal temperature after the exposure were estimated, hourly for a few hours immediately after exposure and daily subsequently. Rectal temperatures were found to change, the daily variations in most cases showing a transitory fall. The variations in temperature were proportional to the x-ray dose, the fall being more marked as the dose increased. However, the variations seen a few hours immediately after the irradiation showed a different pattern, namely, following a very short period of transitory fall in temperature and a gradual rise which was followed again in a few hours by a gradual fall. When only the heads of mice were irradiated, with the rest of the body shielded by Pb plate, there was a fall in temperature for several days; although in some cases it showed immediately after irradiation a temporary fall followed by a tendency to rise. When the x-ray dose was large, the fall in temperature immediately after irradiation was marked, and it is suggested that irradiation of the head affects the hypothalamus, the center of temperature regulation. However, when the head was shielded by a Pb plate and this temperature-

regulating center protected, changes in body temperature also occurred as following whole-body radiation. Thus, both local and central factors contribute to the radioinduced hypothermia. Blockade of the reticuloendothelial system with Chinese ink aggravated radiation hypothermia, whereas splenectomy or liver injury (with CCl_4) tended to ameliorate it. Various drugs and biologic materials were also tested; thiamin and nucleic acid tended to reduce the temperature drop. (BBB)

17551 RELATIVE HUMIDITY, INOSITOL AND THE EFFECT OF RADIATIONS ON AIR-DRIED MICROORGANISMS. S. J. Webb, D. V. Cormack, and H. G. Morrison (Univ. of Saskatchewan, Saskatoon). Nature, 201: 1103-5(Mar. 14, 1964).

Investigations were made on the effects of uv irradiation on E. coli and Pseudomonas aeroginosa and x irradiation on Serratia marcescens and on the influence of relative humidity and inositol on these effects. The effect of relative humidity was the same for all organisms tested. Under the experimental conditions used, little or no uv irradiation damage occurred above 70% relative humidity, nor were there many deaths occurring in unirradiated aerosols. At about 65% there was a rapid change in the sensitivity to both uv and drying alone, with the maximum rate of change taking place between 65 and 55% relative humidity for uv, and 65 and 45% relative humidity for non-irradiated cells. Some organisms showed an equally sharp increase in sensitivity to drying in the dark between 65 and 55% relative humidity. With uv irradiation relative humidity changes below 55% had little or no effect on the death rate and the same was true for non-irradiated cells below 45% relative humidity. Under all experimental conditions, with the possible exception of a relative humidity region around 40%, inositol completely prevented inactivation of the cells or viruses in the dark or under uv irradiation. Under x irradiation the cells were more stable at relative humidity values below 50% than at higher values, and once again the region in which a pronounced change occurred was between 50 and 70% relative humidity.(P.C.H.)

17552 INFLUENCE OF GAMMA-IRRADIATION ON SULPHUR-35 MINERALIZATION OF STERNUM AND TIBIA, AND WEIGHT OF SPLEEN AND TESTES OF CHICKS. H. Patrick and W. G. Martin (West Virginia Univ., Morgantown). Nature, 201: 1340-1(Mar. 28, 1964).

Cockerel Leghorn chicks were given 1200 or 1400 r doses of ^{137}Cs γ rays. Twenty-four hr after irradiation, 5 μC ^{35}S was administered subcutaneously to control and irradiated chicks. The animals were killed 24 and 120 hr after treatment and sternum, tibia, spleen, and testes were removed and weighed. Sulfur-35 contents of the sternum and tibia were determined. Results show gamma radiation damages the spleen and testes and reduces ^{35}S loss. Sulfur-35 retention was similar at both levels of irradiation, indicating that 1200 r doses are sufficient for sulfur metabolism reduction. (H.M.G.)

17553 EXPERIENCE WITH THE TESTING OF RADIOSENSITIVITY IN CANCER OF THE UTERINE CERVIX. J. Antos and O. Nyklicek (Regional Inst. of Public Health, Hradci Kralove, Czechoslovakia). Neoplasma, 9: 555-62(1962).

Studies were conducted in 100 patients with cancer of the uterine cervix, who had been treated by radiotherapy more than 5 yr previously, by colposcopy, microbiology, and cytology tests. Particular attempts were made to determine the sensitivity of tissue to radiation by the Graham criteria, as expressed by radiation response (RR) and sensitization response (SR). It appeared from the results that the assessment of prognosis of radiotherapy according to the cytological diagnosis of RR can be best utilized in women who are still menstruating. The assessment of prognosis on the basis of SR determination proved less valuable. The occurrence of cells showing a SR seemed to be influenced by the following factors: hormonal status of patients: the lower the estrogen level, the higher the SR; inflammatory factors: Trichomonas vaginalis and other microorganisms, affecting the superficial layers of the vaginal epithelium, give rise to false high SR; state of vacularization of the carcinomatous process, which determines the exfoliative processes of carcinoma tissue and the extent of necrobiosis; and state of immunologic processes and by the resistance of the organism. A good RR was found in 70% of women surviving 5 yr compared with only 3.4% in those dying within the 5-yr period. If only menstruating women were considered, the respective values were 93 and 20%, showing the greater reliability of RR as a criterion in this younger group of women. A high SR was found in 46% of surviving and 54% of nonsurviving women (66 and 44%, respectively, in the menstruating group), showing the lower reliability of SR as compared with RR. (BBB)

17554 HISTOCHEMICAL STUDIES ON THE ACTION OF β-RAY IRRADIATION ON THE CONJUNCTIVAL EPITHELIAL CELLS. I. INFLUENCE OF β-RAY IRRADIATION ON THE SUCCINIC DEHYDROGENASE SYSTEM. N. Matsuo, M. Mizushima, and E. Hagsegawa (Okayama Univ., Japan). Nippon Ganka Kiyo, 14: 107-12(Apr. 1963). (In German)

After irradiation of the palpebral conjunctiva of rabbits with ^{90}Sr β rays (5400 rep/min for 1, 5, 10, 15, 30, and 60 min), histochemical changes of succinic dehydrogenase activity were studied. The activity decreased after irradiation; the longer the irradiation time, the more marked the decrease. The enzymically produced diformazan granules became coarse and vacuolated even after 5-min irradiation. It was speculated that the observed decrease of the activity of the succinic dehydrogenase system following irradiation resulted from both the damage to the enzyme itself and the destruction of mitochondrial structure. It was also speculated that the decrease of the activity of the succinic dehydrogenase system constitutes an important factor of the curative and adverse side-effects, resulting from β-ray treatment of ocular structures. (BBB)

17555 ESTIMATION OF RADIATION-INDUCED MUTATION RATES IN MAN. Katumi Tanaka (Tokyo Medical and Dental Univ.). Nippon Idengaku Zasshi, 36, Suppl.: 42-9 (Dec. 1961).

A survey was conducted by questionnaire method among 4793 radiological technicians, all the members of the Japanese Society of Radiation Technology and of the Japanese Association of X-ray Technicians. Of these, 82% sent answers. Analysis of part of these data revealed a higher sex ratio in offspring in the exposed group than that in those in the unexposed group. The respective male/female ratios were 0.5172 and 0.5364, compared to 0.5135 for the Japanese population. For checking the accuracy of the data thus collected, direct contacts were made with about 500 married technicians picked at random from those who responded. This study, when complete, is expected to give more reliable data for the estimation of mutation rate due to chronic irradiation, which is the most important exposure source in man. Since there are only a few female x-ray technicians in Japan, no estimation could be made on the effect of sex-linked recessive lethal mutation from the

data of their children. However information can be obtained for this purpose from data for the offspring of daughters born of exposed fathers. These data seem to be more suitable for the estimation of the genetic effects of chronic irradiation than the data for the children of exposed mothers, because the effect of age of mothers could be excluded more easily in the former, than in the latter. An equation was derived for estimating the doubling dose from the sex ratio of offspring of irradiated (R_1) and nonirradiated (R_0) parents. The estimates of the doubling doses corresponding to various rates of stillbirths and abortions, from 6 to 20%, and sex ratios of abortive and stillborn babies from 0.52 to 0.66, by means of the derived formula and assuming $R_1 = 0.513$. If R_0 is between 0.54 and 0.56, and the rate of fetuses lost in all gestation stages is estimated as between 0.15 and 0.20, the doubling dose may be estimated at 23 to 53 rad per generation. The tentative estimates of the induced mutation rates in man per locus per generation are tabulated. (BBB)

17556 RADIATION-INDUCED MORTALITY OF PREVIOUSLY SPLENECTOMIZED MICE. Masatoshi Sakka and Kiyohiko Sakamoto (Tokyo Medical and Dental Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 835-7(Oct. 1963).

Experiments are described which were performed to demonstrate that radiation-induced hematological death occurs more frequently in previously splenectomized mice than in normal mice receiving the same dose. (from NSA of Japan)

17557 THE RELATION BETWEEN THE CHEMICAL STRUCTURE AND BIOCHEMICAL PROPERTIES OF UNSATURATED FATTY ACIDS IRRADIATED WITH THE X-RAY. Sachiko Ohara and Kozo Utsumi, et al. (Okayama Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 941-52(Nov. 1963).

Changes in chemical structure and biochemical properties of x irradiated fatty acid and the relationship between the chemical structure of fatty acid and its biological action on the membrane system of the cell were studied. Unsaturated fatty acid is autoxidizable in air environment. An increase of lipid peroxide and a decrease of iodine and acid values are observed after a certain period of autoxidation at 30°C. The speed of the autoxidation is accelerated by x irradiation. The x irradiated fatty acid has a capacity to shift its double bond and to form a large quantity of lipid peroxide and carbonyl compounds. The x irradiated fatty acid has a strong effect on the membrane system of the cell, showing a decrease of succinic dehydrogenase activity and an increment of mitochondrial swelling. The stain-ability of the cells to nigrosin, the degree of mitochondrial swelling, and the rate of uncoupling of oxidative phosphorylation are increased by the labile and oxidizable fatty acid derivatives that have double bonds, conjugated double bonds, cis form of double bond, and erythro form of OH isomer. The membrane-damaging activity of the linoleic and oleic acid derivatives that have different kinds of acyl bonds increases in the following order of fatty acid: alkaline salts, free fatty acids, monoglyceride, fatty acid ester, and triglyceride. In the same bound form of acyl derivatives of fatty acid, the activity is larger in the fatty acid having the more hydrophyric and smaller molecule. (from NSA of Japan)

17558 RADIATION EFFECTS ON BONE MARROW FUNCTION. THE RELATIVE BIOLOGICAL EFFECTIVENESS OF 200-kvp X-RAYS, COBALT-60 GAMMA RAYS, AND 15-Mev X-RAYS. Yoshimasa Tanaka and Masatomo Hashi (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1036-44(Dec. 1963).

Iron turnover rates of rat plasma and erythrocytes were studied 24-hrs after whole-body irradiation with doses of 50 to 400 rads. The RBE values of ^{60}Co γ rays and 15-Mev x rays compared with 200 kvp x rays were determined from these bone marrow functions. The decrease of ^{59}Fe uptake was found to be exponentially related to dose. Radioiron disappearance time was prolonged after irradiation, and the half time was also extended exponentially relative to dose. The ^{59}Fe concentration in irradiated femoral bone was much larger than that in non-irradiated femoral bone. The RBE values were tabulated and ranged from 0.72 to 0.90. (from NSA of Japan)

17559 THE RELATIVE BIOLOGICAL EFFECTIVENESS OF X-RAY, Co^{60} GAMMA-RAY, AND 14.1 Mev FAST NEUTRON FOR ACUTE DEATH IN MICE. Shozo Sawada and Haruma Yoshinaga (Hiroshima Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1080-4(Dec. 1963).

Adult female mice were exposed to single whole-body radiation of 2000 Kvp x rays, ^{60}Co γ rays, and 14.1 Mev fast neutrons. From the probit regression lines on 30-day mortality of mice following exposure to each radiation, it was determined that the $LD_{50/30}$ was 640 rad for 200 Kvp x rays, 870 rad for ^{60}Co γ rays, and 560 rad for 14.1 Mev fast neutrons. When the RBE of x rays is assumed to be 1.0, the RBE of γ rays is 0.7 and that of fast neutrons is 1.1 for $LD_{50/30}$. (from NSA of Japan)

17560 COMPARATIVE STUDIES ON THE LETHAL EFFECTS OF X-RAY, Co^{60} GAMMA-RAY, AND 14.1 Mev FAST NEUTRON ON MICE. Shozo Sawada (Hiroshima Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1085-93(Dec. 1963).

The body-weight curves of 30-day survivors of female mice exposed to 200-kvp x rays, γ rays, and 14.1-Mev fast neutrons were compared. The curves of mice exposed to x rays and γ rays equivalent to $LD_{50/30}$ tended to have 2 peaks in weight loss, one between the 4th and 5th day after irradiation and the other at the end of the 2nd week. The later peak was generally larger, especially in the γ-ray irradiated groups. The neutron-irradiated mice showed a greater weight loss on the 5th day after irradiation than the x ray or γ ray irradiated mice, but a later peak of weight loss was not observed. (from NSA of Japan)

17561 LEUKEMOGENIC ACTIVITY OF CELL-FREE FILTRATES FROM RADIATION-INDUCED LEUKEMIA OF RF MICE. Kiyoshi Hiraki, Shozo Irino, Susumu Sota, and Koji Ikejiri (Okayama Univ., Japan). Nippon Ketsueki Gakkai Zasshi, 25: 44-9(Dec. 1962). (In Japanese)

The incidence of leukemia in RF mice exposed to a single whole-body x irradiation dose of 350 r was 41 (77.4%) out of 53 animals. Of these 41, 20 developed the thymic type and other 20 the nonthymic type of lymphocytic leukemia, while only one developed myelogenous leukemia. Cell-free filtrates from these leukemic RF mice which were exposed to a single whole-body dose of x irradiation were inoculated in newborn mice of the same strain (less than 16 hr old). Two (16.7%) of the 12 inoculated animals developed leukemia on the 357th and 374th days, respectively, after inoculation. Inoculation of the cell-free filtrates from normal mice in the newborn mice of the same strain did not produce leukemia and not one of the nonirradiated mice developed leukemia. The possible role of a virus in the induction of leukemia by x irradiation is discussed. (BBB)

17562 STUDIES OF THE INTESTINAL ABSORPTION OF ^{59}Fe IN PATIENTS IRRADIATED IN THE ABDOMINO-PELVIC REGION. L. Dalla Palma (Università, Florence),

L. Cionini, and A. Miliani. Nuntius Radiol., 29: 597-610 (Aug. 1963). (In Italian)

In continuing research on the functional changes of the small intestine during therapeutic irradiation, the intestinal absorption of the ^{59}Fe and 18 patients irradiated on the abdomino-pelvic region was studied. In order to evaluate the avidity of the tissues for the metal the plasmatic $T^1/_2$ of a dose of ^{59}Fe injected endovenously was simultaneously determined in these patients. The statistical elaboration of the results obtained permitted definition of a mean behaviour characterized by a decrease of the intestinal absorption and by a lengthening of the $T^1/_2$ of the ^{59}Fe in the middle of the cycle of treatment, as well as by an increase of the absorption and an abbreviation of the $T^1/_2$ at the end of it. It was concluded that these results may be due either to an alteration of the intestinal wall which would decrease in the second part of the treatment, or to changes of the erythropoietic activity during the irradiation. (auth)

17563 EFFECT OF X-RAYS ON THE MEDULLAR VESSELS IN RABBITS. Jozef Tarmas and Stanislaw Kosmider (Silesian Medical Academy, Zabrze, Poland). Postepy Hig. Med. Doswiadczainej, 17: 765-70(1963).

Details of the study, and the histological changes observed in the pre- and capillary vessels of the spinal cord of rabbits, which proved dependent in their extent on the dosage of x rays rather than the time since exposure, are described. (OTS)

17564 EFFECT OF RADIOISOTOPE DISINTEGRATION ON CELL CULTURE CELL VIABILITY. Franklin R. Leach (Oklahoma State Univ., Stillwater). Proc. Soc. Exptl. Biol. Med., 115: 665-7(Mar. 1964).

Phosphate labeled with ^{32}P was added to cultures of mammalian cells to obtain a range of specific activities between 0 and 50 mC/mg P. The cells were grown for 24 hr, transferred, and the effects of ^{32}P on viability of cells were determined. Data are presented on the effect of ^{32}P on plating efficiency of the cells. The existence of cells with two levels of sensitivity to ^{32}P disintegration is described. (C.H.)

17565 LYSOZYME ACTIVITY IN RADIATION CHIMERAS. Vu-thi Suu, C. C. Congdon, and A. L. Kretchmar (Oak Ridge National Lab., Tenn. and Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.). Proc. Soc. Exptl. Biol. Med., 115: 825-9(Mar. 1964).

Lysozyme activity in the kidneys of lethally irradiated mice treated with homologous bone marrow (HBM) was markedly elevated during the 2nd week after irradiation and transplantation compared to the normal, isologous bone marrow (IBM)-treated or controls which were irradiated only. Measurement of lysozyme activity on day 9 in the normal, IBM, HBM, and irradiated control groups showed levels of 180, 350, 459, and 29 μg/g of bone marrow, respectively. In the same groups on day 9 the kidney levels were 28, 42, 196, and 21 μg/g of tissue, respectively. Measurements were also made on small intestine, lung, spleen, colon, lymph node, submaxillary gland, thymus, liver, and plasma. The changes in lysozyme activity in some of the organs are probably associated with transplantation of granulopoietic elements. Biochemical significance of lysozyme is not known, but it may reflect immunological activity. In some of our lymphatic tissue homogenates examined microscopically not all cells were disrupted, so that the experimental procedure of freezing and thawing the homogenate, then rehomogenizing, was carried out. This increased the enzyme activity yield in nearly every organ studied. (auth)

17566 ACTION OF IONIZING RADIATION ON THE HYDROGEN BOND SYSTEM OF DNA MACROMOLECULES. P. I. Tseitlin, G. P. Yaskevich, and N. I. Ryabchenko (Inst. of Experimental Biology, Moscow and Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 4: 3-9(1964). (In Russian)

Solutions of DNA from calf thymus were x-irradiated. Spectrophotometric observations of 0.002% DNA solutions in 0.2M NaCl irradiated with 0 to 20 kr showed no increase in absorption in the ultraviolet, but with 40- to 59-kr irradiation, increases in absorption occurred. Irradiation doses that had no effect on the absorption at room temperature markedly lowered the melting temperature, and increasing the irradiation dose made the melting profile worse. The data showed that, despite the relatively small change in molecular weight of the irradiated (e.g., 20-kr) 2-strand DNA, the actual molecular weight of the complementary units, in which melting of the ordered system of hydrogen bonds takes place, is about threefold less than that of the critical molecular weight (100,000 vs 300,000) at which the melting temperature becomes independent of the molecular weight. These effects are attributed to the presence in DNA of a single break, which divides a single ordered hydrogen bond system into a series of independent units. Because of this low molecular weight, these units melt at lower temperatures. 21 references. (TTT)

17567 SPECTROPHOTOMETRIC EVALUATION OF RADIATION DAMAGE TO HEMOGLOBIN. K. I. Pravdina (Inst. of Cytology, Leningrad). Radiobiologiya, 4: 10-17 (1964). (In Russian)

Solutions of rat and pigeon blood hemoglobin, obtained by hemolysis and centrifugation of washed erythrocytes, were x-irradiated for 1 to 120 min at rates of 700 r/min. A hypochromic effect was shown with irradiation increasing from 0 to 80 kr, with the value of ϵ (ratio of irradiated to unirradiated) for rat oxyhemoglobin decreasing from 100 to 75 at 555 mμ and to 55 at 578 mμ. Pigeon hemoglobin was more radiosensitive than rat. The marked dependence of the change on the dose indicated that the absorption at 578 mμ might be used as a criterion of radiation damage. Irradiation of oxyhemoglobin sharply increased the absorption at 630 mμ, indicating an increase in the methemoglobin. However, values were too variable for this to be used as a criterion. With 56 kr irradiation, considerable change occurred in the protein part of the molecule, with appearance of globin-hemochromogen spectral lines. Oxyhemoglobin irradiated at 2 to 7 kr and incubated at room temperature in 0.019N NaOH was more susceptible to formation of these lines than the unirradiated. Oxygen effects and after-effects were observed in the irradiated solutions. (TTT)

17568 SOME QUESTIONS ON THE THEORY OF BIOLOGICAL ACTION OF FAST NEUTRONS. A. M. Kuzin (Inst. of Biological Physics, Moscow). Radiobiologiya, 4: 18-22(1964). (In Russian)

The literature (27 references) is reviewed on the relative biological effectiveness (RBE) of irradiation by neutrons in comparison with γ rays. From the classical target theory, neutron irradiation should be less effective because of the high ionization density and high loss of energy in passing through a structure. However, numerous experiments have shown that neutron irradiation is more effective than γ. The neutron RBE's for ten tissues, including Drosophila, mice, erythrocytes, embryos, eggs, testicles, and tradescantia are tabulated. The processes of destruction and decay in cells at the moment of irradiation are said to depend chiefly on the dose received and only slightly on

the ionization density. Comparison of acute and chronic radiation effects indicates a higher RBE in the chronic action of small doses of neutrons. The cumulative damage from neutrons is considered different from that due to γ irradiation. The structural-metabolic theory proposed earlier considers the damage due to structural, metabolic, and recovery factors, continuously taking place in the living cell. A formula is presented for calculating the effect. (TTT)

17569 EFFECT OF IONIZING RADIATION ON THE SUBMICROSCOPIC STRUCTURE OF STRIATED MUSCLE. M. M. Gol'dshtein. Radiobiologiya, 4: 23-8(1964). (In Russian)

Electric conductivity measurements were made on frog gastrocnemius muscle before and for 2.5 hr after Co^{60} γ irradiation to 134.4 krad. Immediately after the irradiation, the resistance of the muscle decreased at low frequencies of stimulation (1 to 100 kc), the decrease being progressive with time. With 1 Mc, the resistance did not change. The muscle capacity did not change for 20 min after the irradiation, and a sharp decrease was observed only after 2.5 hr. The rate of swelling of the muscle in distilled water, studied with frog sartorius muscle, increased considerably in 20 min. The optical density, also studied with the sartorius muscle, changed in two phases. At first there was some decrease, but this was followed by an increase. The highest rate of increase in optical density began 3 hr after irradiation. The results indicate that immediately after irradiation significant changes take place in the submicroscopic tissue structures. The changes are apparently related to an increase in permeability of the membranes and decrease in the lipoprotein complexes. These initial changes lead to further changes in capacity and muscle tissue opacity. (TTT)

17570 EFFECT OF RADIATION DAMAGE TO NUCLEO- AND LIPOPROTEIN OF MEMBRANES AND VELOCITY OF ENZYMIC REACTIONS. A. G. Pasynskii, M. S. Volkova, and L. V. Komarova. Radiobiologiya, 4: 29-35(1964). (In Russian)

The increased penetrability of the nucleoprotein membranes that results from irradiation was studied. The system used was a suspension of crystalline peroxidases (particle size 0.4 to 1.0 μ) separated from the substrate, ascorbic acid, by a thin layer (160 A) of ribonucleoprotein. The increase in velocity of the oxidation of the ascorbic acid resulting from an irradiation of 20 to 70 kr was approximately linear. This indicates that damage occurs from one or two ionizations, that is, at one or two points in the membrane, which contains thousands of molecules. In an artificial lipoprotein membrane system irradiation of 20 to 75 kr did not affect the rate of ascorbic acid oxidation. Higher doses were not tried since they would inactivate the enzyme. In a suspension of isolated mitochondria, prepared from rat liver, the rate of dehydration of succinic acid was not changed by irradiation doses of 0.1 to 20 kr. During the course of this work, a method was developed for determining fumaric acid in the presence of other acids of the tricarboxylic acid cycle. The method is based on the characteristic polarographic wave of fumaric acid and has a sensitivity of 5×10^{-4}M. (TTT)

17571 SIGNIFICANCE OF WATER IN RADIATION DAMAGE TO ERYTHROCYTES. K. S. Trincher and A. M. Kuzin (Inst. of Biological Physics, Moscow). Radiobiologiya, 4: 36-40(1964). (In Russian)

Erythrocytes were gamma-irradiated (^{137}Cs) in physiological saline suspension, in a close-packed condition, in the presence of glucose, and in whole blood. The dose was 5×10^3 r at a rate of 700 r/min. Damage was determined by measuring the optical density as a function of time. The close-packed samples showed 20% protection compared to physiological saline. A suspension of erythrocyte irradiated in the presence of glucose showed 55% protection compared to that in the absence of glucose, and whole blood showed 80% protection, compared to that in physiological saline. The results plus calculations indicate that in physiological saline 55% of the damage is caused by short-lived water radicals originating outside the cell and 20% directly by damage to the macromolecules of the erythrocyte membrane. The remaining 25% of the damage is not explained by these experiments. The data also show an increased radiation sensitivity of the whole cellular structure in physiological saline. The appearance adjacent to a unique cellular structure of a protein-free layer of water 30 to 40 A thick, which corresponds to the path length of a short-lived water radical, should sharply increase the radiation sensitivity of a cellular structure. (TTT)

17572 ROLE OF OXYGEN IN INACTIVATION OF DRY ENZYMES. E. E. Ganassi, L. Kh. Eidus, and R. A. Arifulina (Inst. of Biological Physics, Moscow). Radiobiologiya, 4: 41-6(1964). (In Russian)

Purified (by ion exchange) commercial pepsin and a British preparation were gamma-irradiated by a Co^{60} source; the preparations were held in capillary evacuated tubes or in dry air. The irradiation rate was 750 r/sec. Damage to the enzyme was observed by its loss of enzyme activity both in air and under oxygen-free conditions. Irradiation was at −196°C with 10^7 r and at 45°C with 7×10^6 and 1.5×10^7 r. Damage from irradiation in air was about the same as from irradiation in a vacuum, and increased both with increasing temperature and increasing radiation dose. Damage determined in vacuum was less than that determined in air. It is concluded that inactivation takes place in two stages: formation of long-lived latent damage and development of damage under the influence of oxygen. A necessary condition for the second stage is the presence of water. Dry oxygen does not bring about the damage. Analysis of literature data (30 references) indicates that the radiation inactivation scheme applies to other enzyme systems as well. (TTT)

17573 RADIATION SENSITIVITY OF RIBONUCLEASE AS A PART OF A SYNTHETIC DNA-RIBONUCLEASE COMPLEX. T. Yu. Ugarova, B. S. Diskina, and P. I. Tseitlin (Scientific Research Inst. of Virus Preparation, Moscow and Inst. of Experimental Biology, Moscow). Radiobiologiya, 4: 47-51(1964). (In Russian)

Synthetic DNA-ribonuclease complexes were obtained and characterized. The DNA was obtained from calf thymus, and the RNAase was a commercial preparation, heated to inactivate any impurities. The DNA-RNAase complexes were made in citrate buffer and separated by centrifuging. The enzymic activity of the ribonuclease was determined with RNA as substrate, the acid-soluble RNA being determined spectrophotometrically. RNAase was considerably more inactivated by x irradiation in the complex form than when in the free state. With increasing radiation doses from 0 to 25 or 30 kr, the decreases in activity, 100% being taken as the initial value, were to approximately 60% for RNAase-free or in a mixture with DNA but to about 30% when in the complex form. Free H and OH radicals formed by the irradiation are considered to activate both the surface of the enzyme and the free DNA part. High-energy peroxides and hydroperoxides are formed, and probably the peroxide derivatives oxidized both the DNA part and the

RNAase functional groups, further inactivating the enzyme. These reactions could affect the chromosome level. (TTT)

17574 ACTION OF X RAYS ON DESOXYRIBONUCLEO PROTEIN OF MISGURNUS FOSSILIS SPERM. E. V. Moiseenko (Inst. of Biological Physics, Moscow). Radiobiologiya, 4: 52-9(1964). (In Russian)

The effect of radiation on the velocity of tryptic digestion of three types of DNP was studied: precipitated, filament (straight chain), and heads of Misgurnus fossilis sperm. When the DNP (all three types) was incubated with trypsin, even with 100 kr irradiation there was no release of DNA in 60 min. However, when trypsin was present, even with 1 kr irradiation, DNA release was rapid. In 60 min incubation the order of the velocity of DNA release was precipitated > filament > sperm head for the first 30 min. After that, the filament rate decreased. The sperm head preparation was incubated an additional time, to 90 min, and the rate sharply increased in the last 30 min. The radiation effect increased rapidly with increasing radiation dosage from 1 to 10 kr, but then leveled off for the filament and sperm-head preparations; the effect was constant for the precipitated. The effect of 5 kr irradiation on the filament preparation was the same as that for 40 kr on the sperm-head preparation. A hyperpolymerized form separated from all three types differed considerably in its properties. (TTT)

17575 DEPENDENCE OF THE RADIATION SENSITIZING EFFECT OF OXYGEN ON ITS CONCENTRATION AND THE LIFETIME OF FREE RADICALS. V. P. Paribok (Inst. of Cytology, Leningrad). Radiobiologiya, 4: 60-2 (1964). (In Russian)

The dependence of the radiosensitizing effect of oxygen on its concentration is explained in a mathematical development that compares the impacts of oxygen molecules with the same biomolecule and the lifetime of free radicals originating in the irradiation. In a living cell the short-lived free radicals are considered to react with oxygen only when they come in contact with it. The probability of this reaction is determined by the lifetime of the radicals and the time between two collisions with the same radiosensitive substrate. Obviously, at higher oxygen concentrations in the medium (which are dependent on the concentration in the atmosphere above the medium), the intervening time is less. The time interval calculated for aqueous solutions of oxygen in equilibrium with 2% oxygen in the gaseous phase, i.e., the concentration of oxygen at which radiosensitivity is approximately maximum, is 4×10^{-3} sec. Since the radiosensitivity is maximum when this time is equal to the lifetime of the radicals, the life of the latter should be easily calculated. However, this is not entirely true. Actually, the effective cross section of the reaction of the radicals with oxygen within the limits in which the radicals and oxygen can react is not entirely coincident with the cross sections of the radicals and oxygen. (TTT)

17576 STUDY OF THE OXYGEN EFFECT AT DIFFERENT IRRADIATION RATES. I. B. Bychkovskaya and G. K. Ochinskaya (Central Scientific Research Inst. of Medical Radiology, Ministry of Health, USSR). Radiobiologiya, 4: 63-6(1964). (In Russian)

Experiments were carried out on the survival of beetles x-irradiated at rates of 500 and 50 r/min, to total doses of 3.5 to 12 kr. The percentage of survival on day 50 decreased to 2 to 3% for both groups, with a total dose of 7 kr and to zero at 8 kr. With a total of 7 kr and a rate of 500 r/min, the survival rate depended on the oxygen concentration of the medium, decreasing from 100% at 2.2% oxygen to 20% at 4% oxygen, and to zero at 8% oxygen. At a dose rate of 50 r/min, the survival was zero at 6.6% oxygen. Thus, despite a tenfold difference in the dose rate, the oxygen effect was the same for the two levels. It is concluded that the value of the oxygen effect at different dose rates cannot be determined by a simple quantitative relation between radical and oxygen concentrations. In the experiments described the radiation damage to the beetles depended on very slight changes in the oxygen concentration and not on a tenfold variation in the dose rate. The results are considered applicable to other biological subjects. The data do not invalidate the possible significance of these relations for impulse radiations at very high rates, e.g., 10 to 30 krad at 2 mC/sec. (TTT)

17577 TIME-EFFECT CURVES IN IRRADIATION OF RESTING SEEDS OF DIFFERENT MOISTURE CONTENTS. N. A. Poryadkova (Inst. of Biology, Sverdlovsk, USSR). Radiobiologiya, 4: 67-71(1964). (In Russian)

Resting pea seeds were dried over sulfuric acid to a moisture content of 9 or 18% and were then gamma-irradiated to 15 kr, by a ^{60}Co source, at a rate of 20 r/min. After being soaked in water, they were put into moist sand to germinate. The root tips that formed were fixed and examined at 28.5 to 50 hr after the beginning of sprouting. Mitotic cells with micronuclei were observed in insignificant numbers only after 50 hr. Therefore, in the earlier examinations the cells seen were in their first divisions. At 28.5 hr the number of damaged cells was the same in the two series. However, those with the higher moisture content showed the percentage of damaged cells decreasing rapidly with time. Especially noticeable was the percentage of cells with fragments. In the lower-moisture-content cells the percentages of cells with both abnormal mitoses and with fragments remained high. The percentages of cells with initial damage were about the same for the two moisture contents up to 45 hr, but at 50 hr they became much lower for the 18% moisture state, 58 vs. 91%. This change at 50 hr is obviously related to the beginning of the second mitosis. The results confirm the earlier suggestion that the moisture content of a resting cell does not so much affect the initial damage but determines the recovery of damaged cells. (TTT)

17578 CHANGE OF FATTY ACID CONTENTS OF TISSUE CULTURES AFTER GAMMA IRRADIATION. B. V. Leonov and M. A. Lomova. Radiobiologiya, 4: 72-5(1964). (In Russian)

Cell cultures were exposed to ^{60}Co gamma radiation, at a rate of 270 r/min, to a dose of 400 r, and four days later biochemical and histochemical studies were made. At this time the moist weights of the irradiated and control cells were about the same, 46 and 45 mg/10^7 cells, respectively. The dry weight averaged 10% of the moist weight. The nitrogen contents were also about the same, 0.52 and 0.50 mg/10^7 cells, respectively. However, the fatty acid contents of the irradiated were 18.2% of the dry weights, while those of the controls were around 10.2% (3.27 and 1.81 milliequivalents per 10^7 cells). Thus the ratio of milliequivalents of fatty acid to milligrams of nitrogen was increased by the irradiation, from 3.6 in the controls to 6.3 in the irradiated preparations. The increase in lipids may result from a higher synthesis rate, lower consumption, or even from an increased absorption of lipids from the nutrient medium. Stained histological preparations did not show the difference in fatty acid contents, possibly because of the qualitative rather than the quantitative nature of such comparisons. The increase may be a protective action, since there is evidence that cells with higher lipid contents are more stable to the action of radiation. (TTT)

17579 MODEL FOR PLOTTING THE EFFECTIVE DOSE AND REACTIVATION OF YEAST CELLS IRRADIATED BY ULTRAVIOLET. E. N. Kabakov (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 4: 76-82(1964). (In Russian)

Experiments were carried out on the diploid yeast Saccharomyces vini suspensions of the cells which were irradiated with ultraviolet. Semilogarithmic plots of the inactivation as a function of the radiation dose were the characteristic dose-effect curves for yeast. The typical curves of photoreactivation and dark recovery are presented and compared as survival curves, which show no essential differences. An equation is presented which describes the curves. A comparative analysis of the relation of the types of inactivation in ultraviolet irradiation and the postirradiation recovery indicated that photoreactivation may be described by plots of the effective dose. In the case of dark recovery, this model is formally applied but does not reflect the nature of the process. (TTT)

17580 TIMES OF DEVELOPMENT OF LATENT RADIATION DAMAGE IN DIPLOID YEAST CELLS. V. I. Korogodin (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 4: 83-91(1964). (In Russian)

Suspensions of cells of the yeast Saccharomyces vini were irradiated and then incubated in a medium containing grape. Curves of survival percentages vs irradiation dosage showed a steady decrease in the survival rate, reaching 0.03% at 300 kr immediately after irradiation. The values after 48 hr irradiation likewise decreased as a function of dose rate, but the percentage survival was 10% at 300 kr. The number of cells in a microcolony at 24 hr after irradiation decreased from 77% having 12 or more with 100 kr to less than 0.6% at 356 kr. The irradiated cells were washed after different time intervals and suspended in distilled water, and were examined for survival rates immediately, 24 hr after, and 48 hr after, for doses from $LD_{28.7}$ to $LD_{0.03}$. The relative contents of cells capable of recovery depended on the length of the incubation of the irradiated yeast in the nutrient medium. With increase in the content of the irradiated populations of budding cells, resulting from their incubation in the nutrient medium after irradiation, there was a decrease in the cells able to recover. Two explanations are offered: either the latent damage due to irradiation develops gradually, or this development is confined to a definite period of the life cycle, e.g., the bud-forming stage. The experimental data were analyzed mathematically. (TTT)

17581 RADIATION SENSITIVITY OF THE SINGLE-CELL ALGAE CHLORELLA VULGARIS. I. A. Zakharov and V. V. Tugarinov (Leningrad State Univ.). Radiobiologiya, 4: 92-5(1964). (In Russian)

Chlorella vulgaris cultures were grown in a nutrient medium and were then x irradiated in distilled water, and cell survival rates were plotted semi-logarithmically as a function of dose. The survival rate decreased approximately linearly with increasing dose, to almost zero at 80 kr. The LD_{50} was approximately 14.5 kr. The frequency of pigmented mutations was approximately linearly dependent on the dose. Within the range of doses studied, no decrease in the frequency of the induced mutations was observed for doses resulting in high mortality. The curves indicate that many structures in the cell are damaged by the irradiation. The results are taken to indicate multinucleate or polyploid cells in Chlorella. The low frequency of nonphotosynthesizing mutations indicates that their accumulation resulting from the single irradiation of a culture cannot significantly decrease the biological action of the whole cell population although continuous irradiation might act differently. The increased frequency of the mutation with increasing dose is indicative of the feasibility of using high doses of ionizing radiation in the radiation selection of Chlorella. (TTT)

17582 FORMATION OF ELONGATED FORMS OF E. COLI UNDER CONTINUOUS GAMMA IRRADIATION. B. D. Zhestyanikov (Inst. of Cytology, Leningrad). Radiobiologiya, 4: 96-101(1964). (In Russian)

Observations on E. coli in a phase-contrast apparatus showed considerable numbers of elongated and filament forms in cultures cultivated with sub-bacteriostatic concentrations of erythromycin (25 to 30 μg/ml) or at 46°C for 18 hr under continuous gamma irradiation. These abnormal cells seldom appeared after several generations without gamma irradiation. In two of the strains the elongated forms had up to 30 to 60 nuclei, and in another, up to ten nuclei per form. With appearance of the elongated forms the radiation resistance of the cultures increased.. The dose dependence curve was S-shaped. This S shape is related to the accumulation of large numbers of elongated and undivided forms, although the correlation does not always exist. Other factors can also result in radiation resistance, and the factor causing inhibition of cell division without stopping growth is considered the factor that results in increased radiation resistance. (TTT)

17583 AUTORADIOGRAPHIC STUDY, WITH ^3H THYMIDINE, OF DNA SYNTHESIS, IN LIVER CELL ELEMENTS OF THE WHITE RAT AFTER TOTAL X IRRADIATION. N. D. Gracheva (Central Scientific Research Inst. of Roentgenology-Radiology, Leningrad). Radiobiologiya, 4: 102-7(1964). (In Russian)

Young and adult white rats, weighing from 80 to 200 g, were whole-body x irradiated to 600 or 770 r and ^3H-thymidine (0.5 μC/g) was administered up to 240 hr afterwards. After sacrifice at from 4 to 48 hr after thymidine administration, sections were made on sensitive plants and the autoradiographs were examined. The results indicated that these radiation doses inhibited the entry of the liver cell elements into the DNA synthesis and mitosis phases. At the tenth day after irradiation, in comparison with the control animals, DNA synthesis and mitosis took place in large numbers of cells, which could indicate repair after damage by ionizing radiation. The rate of post-irradiation proliferation corresponded to a low proliferation activity of liver cell elements in normal animals. X irradiation damaged the liver cells in the interphase; with the advance of the repair process after x irradiation damage, the time of parenchymatous and Kupfer cell regeneration became normal. (TTT)

17584 ESTIMATION OF THE REPAIR OF RADIATION DAMAGE BY STUDYING MYEOLOPOIESIS IN DOGS WITH REPEATED EXPOSURE TO IONIZING RADIATION. V. A. Rezontov. Radiobiologiya, 4: 108-13(1964). (In Russian)

Thirty-seven dogs from 2 to 5 yr old were gamma-irradiated (from a Co source) at 7 r/min to 300 rads ($LD_{10/30}$). Forty to 50 days after the irradiation the blood leukocyte level was high, but at 70 to 80 days the level had fallen. Cytological studies confirmed the initial stimulation of myeloid tissue and the subsequent decrease in myelopoiesis. Some animals were then irradiated with 300 r, one group at the 45th day, the time of relatively high compensation, and another on the 75th day, the time of the second myeloid tissue regeneration rate decrease. There were nine dogs in each group. Despite the differences in the initial clinical condition of the animals, the rates of recovery of the blood leukocyte levels after irradiation appeared at first to be the same, but the ratio of these rates (k =

thousands of leukocytes/mm^3/day) to those in the first irradiation (k_0) became $k/k_0 = 0.268$ and 0.300, respectively. Study of the rate of recovery in 19 dogs irradiated to 300 rads after apparently complete restoration to normal showed k/k_0 ratios of 0.348 and 0.465, respectively, for ten animals irradiated five months after the first insult and nine irradiated at 15 months. (TTT)

17585 EFFECT OF THYROIDECTOMY ON THE RESISTANCE OF RATS TO IRRADIATION. N. N. Petrishchev (Pavlov Academy Medical Inst., Leningrad). Radiobiologiya, 4: 114-17(1964). (In Russian)

Male white rats weighing 150 to 200 g were totally thyroidectomized; the parathyroids were also removed since most adult white rats have auxiliary ones. Two weeks later their temperatures averaged 1.4°C below normal and most had 16% lower blood erythrocyte levels and also lower leukocyte levels. A month after the operation 30 of the thyroidectomized rats, plus 25 controls, were irradiated with a single dose of 600 r; two weeks after the operation 10 operated and 10 controls were irradiated with 300 r. In the 600-r group, of the animals dying the first week the weight of the experimental group had decreased 20% by the seventh day, compared with 16% in the controls. After two weeks differences in weight were not significant. The blood leukocyte levels in the experimental group did not differ significantly from those in the control group on the seventh day, though they were a little higher earlier. The life span of the experimental group was generally shorter, and the total deaths (20 days) somewhat higher than in the controls. Fatty degeneration of the liver on the seventh day to the eighth day was less than in the controls. For the 300-r group, after one week the weights of the experimental and control animals had decreased 7%, but after five weeks the experimental animals were normal and the controls 20% lower. As in the 600-r group, the development of leukopenia did not differ much in the experimental and control animals. Recovery of erythrocyte levels was slower in the experimental than in the control group. (TTT)

17586 ELECTROPHYSIOLOGICAL STUDY OF THE NERVOUS RESPONSE OF RABBITS TO X-IRRADIATION OF THE STOMACH. N. S. Delitsyna. Radiobiologiya, 4: 118-22(1964). (In Russian)

In the first series of experiments eight rabbits were irradiated to 300 r and the bioelectric activity in the splanchnic nerve-hypothalamus-cortex system was studied with electrodes in the splanchnic nerve. The day after the irradiation changes in behavior were not marked, but on the subsequent day there was loss of appetite, a sharp decrease in weight, and diarrhea with fatty or bloody stool. Immediately after the irradiation, impulses in the splanchnic nerve became continuous, reaching a maximum in 1 to 3 hr. The next day increased bioelectric activity was noticed from increase in the frequency and amplitude of the interganglion impulses. In the hypothalamus activity increased, reaching a maximum 30 min to 1 hr after the irradiation, but the next day there was a considerable weakening of the reaction of the hypothalamus on interoceptor stimulation, coinciding in time with the increase in the splanchnic activity. In the cortex of the large hemisphere immediately after, the amplitude in the parenteral and cervical decreased but the next day was not greatly changed. Interoceptor stimulation caused a decrease in the amplitude of the biopotentials of the cortex with subsequent increase in the activity. In the second series, with five animals, conditions were identical except that the electrodes were not used. Changes were the same but developed later. (TTT)

17587 CHANGES IN CELL ELEMENTS IN IRRADIATED BONE MARROW CELL CULTURES. V. I. Biryuzova and V. G. Kondratenko (Inst. of Radiation and Physico-Chemical Biology, Moscow). Radiobiologiya, 4: 123-8(1964). (In Russian)

Primary cultures of bone marrow cells from male white rats (150 g weight) were suspended in a nutrient medium and were irradiated to 500 or 1000 r at a rate of 700 r/min. The gamma radiation source was ^{137}Cs. Three hours after the irradiation the cells were centrifuged and fixed in 1% osmic acid. By means of electron microscope observations, the fine-structural organization of the control cells was shown to consist of two types of cells: reticular and myeloblastic. These retained the basic characteristics of the original cells. However, after gamma irradiation, the surfaces of the nuclei were larger, the internal organization of the mitochondria was disarranged, vesicular degeneration was observed in the Golgi apparatus, and the reticular endoplasmic membrane was seen to be enlarged. The changes indicated the possibility of damage to the process of oxidative phosphorylation and to protein, nuclein, and fat metabolism. Photomicrographs of cell preparations are included. (TTT)

17588 CHANGE IN RADIATION SENSITIVITY OF MICE TESTICLES EXPOSED TO X RADIATION. M. D. Pomerantseva and L. K. Ramaiya (Inst. of Genetics, Moscow). Radiobiologiya, 4: 129-35(1964). (In Russian)

Male white mice, three months old, were whole-body x-irradiated at 33 r/min to 200 or 400 r. At intervals up to 140 days they, along with unirradiated mice, were irradiated with a second dose of 200 r. Testicle changes were observed in histological sections. In these two-stage irradiations, the effects were additive. With an interval of three or four days between irradiations, the weight changes were the same as for mice that had been irradiated to the same level in a single dose. At times 49 to 140 days after the 200-r irradiation, the radiation sensitivity of the testicles was the same as that in unirradiated animals. In the mice initially irradiated to 400 r, at 49 to 70 days after the irradiation the testicle sensitivity had returned to its initial level; however, at 98 to 140 days a small increase in radiation sensitivity was observed. The rate of return to normal was much slower in the testicle than in the organism as a whole. The period of return of radiation sensitivity of the testicle to its original level coincides with that of full restoration of the spermatogonia in the canals, which is the most radiation sensitive stage in the development of the germinal epithelium. (TTT)

17589 MECHANISM OF THE STIMULATING AND DEPRESSING ACTION OF RADIATION IN POTATO TUBERS. A. M. Kuzin, A. Kasymov, and L. M. Kryukova (Inst. of Biological Physics, Moscow). Radiobiologiya, 4: 144-9 (1964). (In Russian)

Halves of potato tubers were gamma-irradiated (^{137}Cs) at a rate of 700 r/min to total doses of 1 to 50 kr. Eyes were then transferred to unirradiated potatoes and vice versa. The lengths of the sprouts of the host tubers to which the 10-kr irradiated eyes were transplanted were, on the 15th to 20th day, nearly twice those of the controls and the weights were nearly triple, with dry weights 1.5 times as great. In the case of transplant of 50-kr eyes, the host sprouts were only 63% of the controls and weights were only 84%, dry weights about half. Sprouts from unirradiated eyes transplanted to 10-kr irradiated tubers were seven times as long as the controls, and dry weights, five times as great; those transplanted to 50-kr tubers were half as long and dry weights were slightly lower. Unirra-

diated eyes transferred to unirradiated tubers, as a second control, were about the same in length and weight as the first controls. The results indicate that the radiation stimulation and depression of growth of the potatoes depends on substances originating throughout the mass of the tuber as a result of the irradiation. In low concentrations these substances stimulate growth of the seedlings, but in high concentration they depress the growth, and in even higher doses completely inhibit growth. The experiments confirm that for stimulation of growth, direct irradiation is not completely necessary, but it is sufficient to irradiate only the parenchyma of the tubers. (TTT)

17590 EFFECT OF WHEAT SEED IRRADIATION ON PLANT METABOLISM. G. V. Il'ina, N. N. Kuznetsova, and S. G. Rydkii (Moscow State Univ.). Radiobiologiya, 4: 150-6(1964). (In Russian)

Carbohydrate metabolism was studied in wheat plants raised from seeds irradiated with 1000 r ^{60}Co γ radiation. A dose of 2000 r had been shown earlier to cause death of a significant number of the seeds. The seeds were grown in sand with standard nutrient solutions and with solutions containing high P, K, or S. Charts are given that show the percentages of monosaccharides, disaccharides, and P in leaves, stems, and germinal portions of the plants grown from these seeds, with breakdowns for the different nutrient solutions and comparison with the controls. The changes in metabolism in the different parts of the plant resulting from the pre-sprouting irradiation of the seeds increased as the plants grew. The changes were reflected in the disturbance in the ratios between the different forms of soluble carbohydrates and between the protein and nonprotein N, with accumulation of monosaccharides and increase in the nonprotein fraction of the total N. The degree to which these changes were shown depended on the nutrient solution, with higher levels of elements that increase the plant activity, i.e., P, K, and S, being able in large measure to decrease the effect of the irradiation. (TTT)

17591 STUDY OF EARLY POSTIRRADIATION EFFECTS IN GAMMA IRRADIATION OF NICOTINIA RUSTICA. E. K. Uzerin (Inst. of Biological Physics, Moscow). Radiobiologiya, 4: 157-62(1964). (In Russian)

Air-dried seeds containing 4.92% moisture and sprouts of N. rustica were gamma irradiated and and the nicotine content determined. The percentage of nicotine present varied as a function of the irradiation dose in 10-day seedlings sprouted from irradiated seeds. Values were higher than those of the controls for seeds irradiated at 0.2 to 1 kr, less for the 2-kr irradiated seeds, and higher again at 5 to 10 kr, and a definite peak at 40 kr, but the drop was considerably below that of the controls at 80 kr. In air-dried seeds the nicotine changed with time, decreasing in an irregular pattern to 50% in ten days with a 1-kr dose, while a 2-kr dose caused practically complete degeneration of the compound. When the irradiated seeds were wet, the presence of nicotinic acid resulted in an increased rate of metabolism and formation of nicotine. Depletion of the precursors in the irradiated seedling decreased the rate of nicotine synthesis. The rate of nicotine synthesis is determined by many factors that do not respond equally to irradiation; this explains the waves in the nicotine levels. The important role of nicotinic acid was confirmed in experiments with seeds in dilute nicotine solutions irradiated in vitro and with infiltration of leaves by nicotinic acid. A 10-kr irradiation of the leaves showed no increase in the nicotine. (TTT)

17592 REACTION OF BONE MARROW TO RADIOACTIVE STRONTIUM (MORPHOLOGICAL STUDIES). P. A. Vlasov. Radiobiologiya, 4: 163-6(1964). (In Russian)

Two hundred male white rats, weighing 130 to 150 g, were injected with neutral red and ^{90}Sr chloride, 0.1 μC/g, which resulted in death after two years. Five animals were sacrificed each month, and stained marrow smears were studied. A definite cycle in the changes in the cells of the marrow was noted. In the first three months, physiological regeneration of the cells destroyed as a result of the direct action of the beta irradiation from the Sr was inhibited. During this time the irradiation rate was calculated as 13 rads/day, or a total of 1 krad. The second period, from the 4th to 5th month to the 8th or 9th month, as the Sr decayed, the dosage decreased and the regeneration process partially returned to normal. The organism's effort to compensate for the incomplete regeneration resulted in an increase in the hemopoietic tissue. The dose here was calculated as 8 rads/day, with a cumulative dose of 2.5 krad. In the third period, from the 13th to the 23rd month, the increase in amount of hemopoietic tissue ceased, and hyperplasia of the bone marrow could be observed. The dose was calculated as low in this time, up to 3 rads/day at the end of the 23rd month. (TTT)

17593 REACTION OF THE THYROID GLAND TO SINGLE ADMINISTRATION OF ^{210}Po. A. V. Tkachev (Inst. of Biophysics, Moscow). Radiobiologiya, 4: 167-9(1964). (In Russian)

Fifty-one male white rats, weighing 150 g, were given ^{10}Po in the amount of 0.02 μC/kg, which is lethal in 150 days. With time, the weight of the thyroid increased, both absolute and relative. Morphological changes were typical of those found in hyperplasia: thicker epithelium, narrower follicles, more colloid resorption, and wider interfollicular capillaries. These were observed on the tenth day, and on the 40th, 70th, and 100th days were observed to have increased progressively. The uptake of ^{131}I by the gland on the tenth day was no different from that in normal animals, but on the 40th day had sharply changed. The curve for ^{131}I absorption by the gland on days 40 to 42 was characterized by a peak at 1 to 6 hr, followed by a rather steep drop. The curve at days 100 to 102 was more like the control in shape but was lower. The noncorrespondence between morphology and function at the later times may be the result of direct damage to the thyroid gland tissue, caused by the Po^{210}, but is more probably due to a functional depletion of the thyroid with hyperstimulation of the thyreotropic hormone of the hypophysis. (TTT)

17594 MUTAGENIC EFFECT OF ETHYLENEIMINE AND GAMMA IRRADIATION ON AIR-DRIED SEEDS OF WINTER WHEAT. N. S. Eiges (Inst. of Biological Physics, Moscow). Radiobiologiya, 4: 170-9(1964). (In Russian)

Data are presented from an analysis of the mutagenic effect of ethyleneimine on winter wheat. The effects are compared with the effects of gamma irradiation. Ethyleneimine appears to be four- to six-fold more effective. Of the mutagens obtained with ethyleneimine concentrations of 0.01 to 0.04%, those of most interest in agriculture are the coarse-spiked types with tall, thick straw types, with resistance to disease, and the highly productive, glaucous types. Of the characteristics obtained in M_2, 77% were inherited in M_3. Completely inherited were the glaucous and clear-green color traits. Increased productivity and disease resistance were not completely inherited. Clubbed head and short-stem characteristics were not inherited at all. The most numerous group was the group of plants with high productivity. The range of mutagens obtained from ethylenimine differed from that obtained from gamma irradiation both in the origin of new types and in the absence of some other types. (TTT)

17595 RATIO BETWEEN DOSE AND ABSORBED DOSE IN IRRADIATION OF SEEDS. N. A. Troitskii and B. I. Avramenko (Inst. of Biology, Minsk, USSR). Radiobiologiya, 4: 180-1(1964). (In Russian)

The relative biological effectiveness of different types of radiation as well as the action of one type of radiation on different objects can be expressed only in units of the absorbed dose in rads. A dosimeter for use in irradiation of different seeds cannot be constructed because of differences in the chemical compositions of the seeds. Therefore a coefficient of x- or gamma-ray-transmission must be used, and the dose is measured in air with an ionization chamber. Formulas are given for calculating the absorbed dose in rads/roentgen. Values are tabulated for elementary contents in various seeds, and the relation between dose and absorbed dose is shown graphically. Also tabulated are values of absorbed dose for radiation of different seeds with radiations of different energies. Values for Cruciferae seeds, which have a high fat content, are close to those for human fatty tissue, and those for wheat are close to values for muscle tissue. The 30% lower value of the coefficient for various Cruciferae than for wheat may partially explain their higher resistance to radiation. (TTT)

17596 ON THE BIOLOGICAL EFFECTS OF COSMIC RADIATION IN HUMAN BODIES. J. Eugster (Universität, Zurich). Raketentech. Raumfahrtforsch., 7: 163-5(Oct.-Dec. 1963). (In German)

Effects of cosmic radiation on human tissues were studied. Thirty-three people, predominantly persons living at high altitudes of up to 3500 m were considered. The formation of stars by interactions of cosmic rays in living tissue was observed. Topographic comparisons were made of the physical track analyses and the histological changes in tissues. The most pronounced cell changes showed a noticeably high correlation to the size of the striking particle. (M.C.G.)

17597 EXPERIMENTAL CONTRIBUTION TO THE PROGNOSTIC SIGNIFICANCE OF PERIPHERAL CHANGES OF THE BLOOD IN THE COURSE OF ACUTE RADIATION DISEASE. Zd. Dienstbier and J. Pospisil (Charles Univ., Prague). Sb. Lekar., 65: 1-7(1963). (In Czech)

Thirty dogs were whole-body irradiated with x-ray doses of 600 r under identical conditions (200 kv, 15 ma with 0.5 mm Cu and 1 mm Al filtration at a distance of 125 cm and at 5 r/min). These were divided, according to the time of death, into four groups and the prognostic importance of changes in the peripheral blood count was evaluated. The first group of two dogs which died up to the eighth day after being irradiated was not evaluated. The second group of 17 dogs died between the 8th and 15th day after irradiation. The third group of dogs died between the 15th and 29th day, and the fourth group of dogs survived the entire observation time of 29 days after irradiation. It was found that the post-irradiation lymphocytopenic reaction was the most reliable criterion of survival. (BBB)

17598 SOME CELLULAR CHANGES INDUCED BY HIGH DOSES OF X IRRADIATION. [PART] I. Vladimir Puza, Karel Lejsek, and Zdena Sefernova (Charles Univ., Hradec Kralove, Czechoslovakia). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradec Kralove, 4: 361-8(1961). (In Czech)

It is proposed that at high radiation doses some aberrations of chromosomes occur as a consequence of damage to single fibers of the spindle. Such an injury may be temporary or permanent. If permanent, micronuclei may develop from the aberrant chromosomes. Multipolar mitoses occur most probably from damage to centrioles, though an important role is played by injury to the fiber of the spindle by radiation. The hypothesis of Lettre concerning persistence of the complex centriole-spindle-chromosome in interphase is discussed and affirmed. By means of this hypothesis is explained the time sequence of changes in the spindle leading to its multipolarity, in such a way that this complex becomes affected as early as in the preprophasic cell. On the basis of the observation of persistent changes in the spindle in its development, it is concluded that the cells survived even the highest x-ray doses used (11,000 r); this was shown by cell division, even if this division was abnormal. (BBB)

17599 SOME CELLULAR CHANGES INDUCED BY HIGH DOSES OF X IRRADIATION. PART II. Vladimir Puza, Karel Lejsek, and Zdena Sefernova (Charles Univ., Hradec Kralove, Czechoslovakia). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradec Kralove, 4: 483-90(1961). (In Czech)

Studies were conducted with cultures of HeLa cells x irradiated by doses ranging from 2,000 to 11,000 r. The occurrence of amitoses and of binuclear and mononuclear cells showed a statistically significant dependence. Investigation of the possibility of amitotic division of the nucleus showed that such a division does exist. The observed increase in the number of amitotic divisions and, at the same time, the increased frequency of multinuclear cells are a result of changes in the metabolism of the cells or cell components and is not dependent on radioinduced changes in the medium. (BBB)

17600 MOUSE LIVER CATALASE ACTIVITY AFTER X IRRADIATION. Milan Praslicka (Safarik Univ., Kosice, Czechslovakia). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 115-18(1963).

Liver catalase activity after a dose of 600 r ($LD_{50/30}$) decreased in about 50% of mice on the 6th day and later after irradiation. In the animals with the more marked drop of liver catalase activity, later more marked loss of body weight, decrease of erythrocyte count, and fatty degeneration of the liver were observed. The observed increase of the catalase activity in spleen and the decrease in blood and liver in the same animals show that the enzyme is not affected chemically but that the content of catalase based on tissue weight diminishes due to impaired synthesis. In the spleen the disintegration of lymphatic and myeloid tissue relatively poor in catalase content occurs so that the spleen catalase activity is mostly in the erythrocytes. In liver the protein content after irradiation diminishes, and the synthesis of new catalase is delayed; therefore, its quantity related to unit weight decreases. Activity of liver catalase was reduced proportionally with the loss of liver nitrogen. Catalase activity of liver extract irradiated in vitro was not affected even after a dose of 20,000 r and the activity of pure catalase in water not even after a dose of 100,000 r. The liver catalase level of healthy organisms shows little variability; in 50 control mice the standard error of the mean was only ±1%, with maximal deviations of −10, and +6%. Hence, liver catalase activity is a good diagnostic and prognostic indicator of radiation damage. (BBB)

17601 CHANGES IN THE BLOOD BED OF RAT LIVERS AFTER IRRADIATION. Jiri Smahel (Charles Univ., Hradec Kralove, Czechslovakia). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 135-6(1963). (In Czech)

After a single radiation dose of 600 r, no differences could be observed in the filling of the blood bed of the liver lobules in rats by the method of injection of gelatin and India ink in the first two weeks. Only in 10% of the irradiated rats was conspicuous focal dilatation of intertra-

becular sinuses, filled with the injection mass, observed. The cells of the trabeculae were degenerate. (BBB)

17602 ELECTRON MICROSCOPY OF MITOCHONDRIA FROM THE LIVER OF RATS AFTER X-RAY IRRADIATION. Ilja Hradil, Jaroslav Kvetina, and Karel Lejsek (Charles Univ., Hradec Kralove, Czechslovakia). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 141-3(1963). (In Russian)

Mitochondria isolated from the liver of nonirradiated rats and those of irradiated rats on the third and sixth day after x irradiation by a dose of 600 r, which is the $LD_{50/30}$ for rats, were examined using the electron microscope. Detectible changes occurred in morphology after irradiation that are discussed in terms of changes in the enzymatic activity of liver mitochondria induced by x rays. (BBB)

17603 THE SIGNIFICANCE OF THE SPLEEN FOR THE REACTION OF THE BONE MARROW TO WHOLE-BODY RADIATION. J. G. Gostomzyk, R. Arnold, and G. Ruhenstroth-Bauer (Max Planck Institut fuer Biochemie, Munich). Schweiz. Med. Wochschr., 93: 1490(Oct. 19, 1963). (In German)

The uptake of ^{32}P by bone marrow was studied in vitro in cells from rats that had received x radiation at a rate of 60 r/min, and from control animals. In the normal marrow the uptake of ^{32}P was linear for the first 20 hr, but the cells from irradiated animals took up ^{32}P as fast as this only for the first 10 hr. The final total uptake was less than in the normal cells. Bone marrow taken from one to two hr after radiation with 800 r shows, in vitro, a decreased ^{32}P uptake that is 50 to 60% less than in normal cells. Marrow cells removed from rats 5 hr after radiation have an almost normal uptake rate. In animals where the spleen was removed before exposure to 800 r, uptake was almost the same as in nonsplenectomized animals exposed to 150 r. Splenectomy, as such, had no effect on ^{32}P uptake 1 day after the operation. The de-decreased ^{32}P uptake after radiation exposure may be due to decreased DNA synthesis. The smaller inhibitory effect of radiation after splenectomy suggests that DNA synthesis in the marrow cells is directly affected by a radiation injury of the cell, and is indirectly affected by a regulative function of the spleen. Studies of the electrophoretic hemocytopherogram showed that 3 to 11 hr after exposure to 800 r the granulocyte fraction was absent, but in its place a rapidly moving fraction appeared. These may be immature cells released from the bone marrow, since the granulocyte blood picture was normal 48 hr after the radiation. If the spleen was removed 48 hr before radiation with 800 r, the granulocyte fraction in the hemocytopherogram was unchanged. The results suggest that the spleen regulates release of blood cells from the marrow into the peripheral blood. There appears to be a definite time- and dose-dependent correlation between the decreased synthetic activity of the marrow cells, as measured by ^{32}P uptake, and increased release of granulocytes from the marrow. Both processes seem to be influenced by the presence of the spleen. (BBB)

17604 COMPARISON OF THE ACTION OF IONIZING RADIATIONS AND BIOLOGICAL ALKYLATING AGENTS (NITROGEN MUSTARDS) AT THE CELLULAR AND SUB-CELLULAR LEVEL. Peter Alexander (Royal Cancer Hospital, London). Sci. Rept. Ist. Super. Sanita, 1: 537-50(Oct. 1961).

A survey of data relating to the mechanism of action of radiomimetic agents shows that ionizing radiations and alkylating agents, such as nitrogen mustards, epoxides, and esters of methane sulfonic acid esters, give rise to very similar types of biological damage. These biological end-effects are initiated by chemical reactions with cell constituents. Radiation damages, with almost equal effectiveness, many vital cell materials and, similarly, alkylating agents combine with proteins, nucleic acids, and many other substances. The possible mode of action of these agents at the molecular level is discussed. A mechanism by which oxygen enhances the radiation lesions of sparsely ionizing radiations is envisaged for membrane damage. (BBB)

17605 COSMIC RADIATION AND CANCER. I. INFLUENCE OF COSMIC RADIATION AT SEA LEVEL ON INDUCED CANCER. Shan-yuan Wang. Sci. Sinica (Peking), 12: 1760-1(1963).

The effect of cosmic rays on methylcholanthrene-induced neoplasia in mice was studied. Cancerous mice were kept under cover of lead plates 1, 2, 5, and 10 cm thick. No shielding was provided for the controls. A statistical assay of experimental data showed that mice protected by a 2-cm lead shield had a shorter latent period of tumor development than any other test group. In addition, photon-electron showers were at their maximum with 2-cm shielding. (OTS)

17606 RADIATION-INDUCED AVERSION TO ALCOHOL. L. J. Peacock and J. A. Watson (Univ. of Georgia, Athens). Science, 143: 1462-3(Mar. 27, 1964).

Mice genetically susceptible to alcohol orientation were allowed to develop a preference for 10 percent ethanol over tap water. A low dose (12 roentgens per hour for 4 hours) of whole-body gamma radiation was used as an unconditional stimulus to produce alcohol-avoidance behavior. A marked aversion to the alcohol occurred but was extinguished within 6 days, owing probably to the very high motivation of the animals to drink alcohol. The study extends the technique of radiation-produced avoidance conditioning to include alcohol consumption as a measure of response in genetically susceptible mice. (auth)

17607 RADIOBIOLOGICAL STUDIES IN PLANTS. VII. CHROMOSOME ABERRATIONS INDUCED BY GAMMA-IRRADIATION IN A JAPANESE WHEAT VARIETY. Ichizo Nishiyama and Sadao Ichikawa (Kyoto Univ.). Seiken Jiho, No. 13, 143-9(Oct. 1962).

A study of the effects of γ irradiation on oats and wheat, especially Triticum vulgare variety Shinchunaga, showed many morphologic and physiologic mutants in the X_2 and the later generations of the irradiated wheat. From the genetic behavior of the mutant characters, it is assumed that most of them were induced through chromosome aberrations. Cytologic and genetic observations on these mutants are described in detail. X_2 plants derived from 118 X_1 spikes and of their progenies ($X_3 - X_5$) which showed aberrant changes in morphologic or physiologic characters were examined cytologically in the meiosis of the pollen mother cells. Of 44 X_2 lines investigated cytologically, 34 showed abnormal meiotic configurations, such as multivalents, univalents, heteromorphic bivalents, aneuploidy, partial asynapsis, or mixoploidy in their progenies. Of 546 plants examined cytologically, 342 (63%) showed chromosome aberrations. Various types of abnormal meiotic configurations and their frequencies are tabulated. The plants with 38 to 45 somatic chromosomes were found in the progenies of the irradiated wheat. Excluding the plants which showed partial asynapsis or mixoploidy, about 50% of plants had 42 chromosomes, 21% had 41, 9% had 40, 9% had 43, 7% had 44, and the remainder had 38, 39, or 45 chromosomes. In the $X_2 - X_5$ progenies were often found various abnormal charac-

ters, e.g., dwarfness, short spike, lax spike, speltoid, compactoid, square head, thick culm, slender culm, bent culm, narrow leaf, and sterility. Most of these abnormalities appeared to be associated with various chromosome aberrations. For instance, speltoid plants had always 42 or less chromosomes whereas compactoid plants had always 42 or more. On the other hand there were some mutants showing only normal 21 bivalents, probably induced through gene mutations. Generally, plants with 42 chromosomes had high fertilities but those with chromosome numbers deviating from 42 showed decreased fertilities. Moreover, wide variations in the fertility were often observed in the plants with the same chromosome number, probably due to the presence of multivalent pairings of chromosomes or other chromosome aberrations. Partially asynaptic plants with 41 to 43 chromosomes usually showed higher seed fertilities than those with 40 chromosomes, most of which were completely sterile and accompanied by dwarfness with a few exceptions. It is proposed that the high sterility and dwarfness might mainly be caused by the nullisomic nature of chromosome constitution. (BBB)

17608 STUDIES ON X-AGENT. VII. TIME FLUCTUATION OF X-AGENT. Hideo Moriyama (Shonan Hygiene Inst., Kamakura, Japan). Tohoku J. Exptl. Med., 73: 147-58(Jan. 25, 1961).

This postulated cosmic agent is said to affect the optical density of suspensions of red blood cells; its intensity varies over time and space, according to the interpretation of these experiments. (BBB)

17609 CELLULAR GROWTH AND TISSUE RADIOSENSITIVITY: CELL STUDIES IN VITRO AND GENERAL CONCEPTS. Andre D. Glinos and Hanson H. North (Walter Reed Army Inst. of Research, Washington, D. C.). Trans. N. Y. Acad. Sci., 26: 145-58(Dec. 1963).

L cells irradiated with various doses of ^{137}Cs γ rays were used to study relative cell radiosensitivity at various phases of the population growth cycle. When irradiated population cell counts were expressed as fraction of their respective controls, cell populations of stationary phase origin appeared to be larger than populations of logarithmic phase origin by a factor averaging 30%. Three growth levels (6, 12, and 18 cells) of logarithmic and stationary cells were irradiated, and the dose required to reduce the irradiated cell populations to 0.37 of their respective controls (^{37}D) was calculated from the straight line portion of the curves. It was found that as relative cell number increased, the values of the ^{37}D as well as the difference of these values between logarithmic and stationary origin cells decreased rapidly. Results are interpreted in terms of radiosensitivity. (H.M.G.)

17610 CELL STRUCTURE AND RADIOSENSITIVITY. Anna Goldfeder (New York Univ., New York). Trans. N. Y. Acad. Sci., 26: 215-41(Dec. 1963).

Studies were designed to correlate the structural changes induced by ionizing radiation with functional events on a subcellular level. The results obtained so far provide the following evidence: the radiation injury to cells in interphase is mediated through the membrane system; the great radiosensitivity of lymphocytes may be explained by the paucity of cytoplasmic organelles, particularly mitochondria; the integrity of the membrane system, including mitochondria, is a critical factor in cellular radiosensitivity; interphase or acute cell death is explained by injury inflicted on the limiting plasma membranes; differential radiosensitivity between various cell types may be explained by the difference in cytoplasmic composition in respect to the quality and quantity of the membrane system including mitochondria; and displacement of intracellular enzyme systems is an underlying mechanism of radiation effects. (auth)

17611 RADIATION PROCTOSIGMOIDITIS: A CASE REPORT. Yasusi Nakamura. Virginia Med. Monthly, 88: 213-16(Apr. 1961).

Radiation injury to the large intestine is described in a 69-yr-old patient who underwent x-ray and Ra treatment for cervical carcinoma. Fourteen yr prior to discovery of rectal bleeding, she received a 1400-mg/hr Ra dose intracervically and 13 yr later 2400-mg/hr Ra and 4000-r abdominal x-ray doses. After bleeding was first noted, radiography revealed a 10-cm-long constriction of the mid-sigmoid segment of the bowel, the lumen being reduced to 1 cm dia. When this segment was surgically removed, an ulcer 8-mm in width and 5-cm deep was found. The ulcer extended through the submucosa and the inner layers of the circular muscle coat. The surrounding tissue was fibrotic and the nearby blood vessels were thickened, but no malignant changes were seen. The surgical technique for removal of the constricted segment is described. (BBB)

17612 ATOMIC RADIATION IN SEWAGE PROCESSING. Hal R. Spragg (Univ. Match Corp., St. Louis). Water Sewage Works, 110: 163-5(May 1963).

Scientists report progress in using ionizing radiation to aid in sewage settling and to reduce foaming. (Public Health Eng. Abstr., 44: No. 3 (Mar. 1964))

17613 STUDIES ON X-AGENT. XIX. DIFFERENCE OF BACTERIAL GROWTH BETWEEN DAY AND NIGHT. Hideo Moriyama and Hiroshi Ueno (Shonan Hygiene Inst., Kamakura, Japan). Yokohama Med. Bull., 13: 207-16 (June 1962).

Observed fluctuations in the rate of growth of bacteria when cultures were begun at different times were attributed to the postulated X-agent. Thus, Proteus vulgaris cultured in peptone solutions showed growth rates which were different depending on the time of inoculation. In investigations performed in the winter months (January and February) in 1959, the bacteria of morning inoculations achieved, after 24-hr incubation, constantly greater growth than those of evening inoculations. However, further investigations carried out throughout the year (from March 1959 to January 1960) gave results which were less consistent, but the bacteria tended to achieve a higher growth rate at night than in the daytime. Sometimes the day-to-night difference tended to be maintained in a similar trend for a few days until it was reversed; then this inverted relation was maintained for several days. It is suggested that the demonstrated difference in bacterial growth between day and night may be caused by day-to-night variation of the X-agent. This difference, however, was less compared with the day-to-day variation; the bacteria showed growth rates varying strikingly from day to day. This suggests that the property and/or the flux of X-agent varies greatly from day to day, while it varies only a little between day and night. It is believed, therefore, that X-agent does not in the main directly emanate from the sun. (BBB)

17614 STUDIES ON X-AGENT. XX. TIME-FLUCTUATION OF X-AGENT IN ITS EFFECT ON PROTEIN SOLUTIONS. Hideo Moriyama (Shonan Hygiene Inst., Kamakura, Japan). Yokohama Med. Bull., 13: 217-30(June 1962).

Slight day-to-night differences were found in the effect of X-agent on the turbidity of protein solutions. These differences were slight and almost insignificant compared with the very pronounced day-to-day differences that were observed. It was inferred that day-to-night difference is caused by some solar factor which can interfere with the

X-agent. This interference appears to be established when the agent is of soft quality. Time fluctuation of X-agent is said to be marked, but the mode of fluctuations unsystematic and extremely irregular. Short-term investigations revealed that the agent is constantly fluctuating with a short periodicity, whereas prolonged observations show that it fluctuates also with long periods extending several weeks or months. During these long periods it may also fluctuate with much shorter periods of a few days or a half day. Evidence is presented that there is also a seasonal variation, with a peak intensity in the early summer in the action of X-agent. (BBB)

17615 THE β AND γ-RADIATION SENSITIVITY OF THE SERUM FACTORS (HEMAGGLUTINATING FACTOR, LATEX PARTICLE-AGGLUTINATING FACTORS 1 AND 2, STREPTOCOCCUS-AGGLUTINATING FACTOR) OF RHEUMATOID ARTHRITIS. Heinz Seifert (Saechsische Serumwerk, Dresden). Z. Ges. Inn. Med. Ihre Grenzgebiete, 18: 157-60(Feb. 15, 1963). (In German)

The radiosensitivity of various components of serum rheumatoid factors was studied by exposing the factors in aqueous solutions to β radiation from added $Na_2HP^{32}O_4$ and to external γ irradiation from a ^{60}Co source. A new classification of rheumatoid factors is presented whereby they are considered in terms of four principal components; these are a hemagglutination factor which is responsible for the sensitized sheep cell reaction, a streptococcus-agglutinating factor responsible for the L agglutination reaction, and two latex-agglutinating factors (1 and 2) which agglutinate latex particles sensitized with gamma globulin. Each of these four factors stimulated formation of a specific antibody when they were injected in rabbits, and each factor could be further separated into agglutinating (a) and precipitating (p) fractions by ultrasonification. The a fractions of all four components were completely inactivated by exposure to 1 mC ^{32}P for 3.25 to 3.75 hr, whereas the corresponding p fractions required only 1.5 to 84 min of exposure to the same amount of β radiation. Thus, the p fraction of latex factor 2 was 137 times more sensitive than the respective a fraction, and the p fraction of hemagglutination factor was 2.5 times more sensitive than the respective a fraction. When the factors were exposed to ^{60}Co γ radiation at a dose rate of 23 r/min, all four a fractions were completely inactivated in 4 to 5 hr, or after total doses of 5544 to 6237 r. In contrast, the p fractions were inactivated after exposures of 11 to 44 sec, or 4.2 to 16.9 r. Thus, the γ-ray sensitivity of p fractions was 369 to 1320 times greater than that of the corresponding a fractions. The heat sensitivities were also markedly greater for p than for a fractions of all four agglutination factors. (BBB)

17616 STUDIES ON THE INDUCTION OF MUTATIONS BY Co^{60} IRRADIATION OF EYE SPROUTS OF THE POTATO. W. Rudorf and K. Woehrmann (Max-Planck-Institut für Zuechtungsforschung, Cologne). Z. Pflanzenzuecht., 49: 397-414(Aug. 1963). (In German)

Sprouting, illuminated potato shoots of the Sieglinde variety potato were exposed to γ rays at doses of 4000, 6000, and 8000 r referred to as series I, II, and III. Nodal cuttings were prepared from the longest shoot of 40 tubers of each series by cutting the shoots through beneath the nodes (basipetal) and growing separately until they became rooted plants. The shorter shoots were left intact and used for making eye cuttings. After storage of the tubers for 37 days at 12 to 15°C with illumination, nodal cuttings were prepared and grown on a further 40 tubers of series II and III (IIa and IIIa). The nodal cuttings of series I, II, and III showed abnormalities in the vM_1 generation, which were expressed as stunted growth, swelling of the nodes, misshapen leaves, formation of aerial tubers and aerial stolons with or without tubers. These abnormalities were both qualitatively and quantitatively essentially independent of the dosage used. The eye cuttings of the same series showed these abnormalities only to a very limited extent. No abnormalities were found among nodal cuttings of series IIa and IIIa grown under identical conditions. The same was true for cuttings coming from severely altered plants of series III (apical cuttings). The growth abnormalities of the nodal cuttings in the three series are considered to be the result of disturbance to the plant hormone system (especially auxins) and are discussed in relation to this system. The lack of abnormalities in the eye cuttings of series I, II, and III is thought to be caused by the damage in entire shoots being more quickly brought into equilibrium again. In the cuttings of series IIa and IIIa, recuperation after growth-hormone damage may have taken place during the 37-day continuous storage period. In vM_2, 42 anomalous plants were identified. The changes involved only leaves, stems, and chlorophyll formation. Changes in other characters could not be observed because of a serious attack by leaf-roll virus and scab. The considerable vegetative division of the series of nodal cuttings did not lead to a higher yield of abnormal plants compared with the eye cuttings. The vM_3 generation was limited to a single tuber from each plant. Morphologic observation in this generation was hindered by invariable attack by leaf-roll virus. Several plants were observed, however, which scarcely showed any symptoms of this disease. Plants in the vM_4 generation from five tubers each of the vM_3 plants showing almost no symptoms were investigated for phloem necrosis. A few clones were recorded as not attacked or only very slightly attacked. The mutant plants in the vM_2 generation showed some somatic segregation in vM_3, indicating a marked chimeric nature for these individuals. (BBB)

17617 STUDIES OF THE SELECTION VALUE OF RADIOINDUCED MUTANTS. Werner Gottschalk (Universität, Bonn). Z. Vererbungslehre, 93: 185-202(1962). (In German)

Air-dried Pisum sativum seeds were exposed to from 7000 to 15000 r of x radiation in steps of 2000 r during the interval 1954 to 1959. The dose rate was ~100 r min. A total of 296 clearly identifiable mutants, as based on fertility characteristics, were produced. Of these mutants, 79 (26.7%) were lethal and died before reaching the generative phase. There were 71 (24%) sterile mutants that grew to maturity, but which were completely sterile because of histological, cytological, or biochemical defects. There were 64 (21.6%) weakly fertile mutants whose seed production was so small that their reproduction was possible only with heterozygotes, but the 82 (27.7%) other mutants were sufficiently fertile to produce pure lines. These mutants showed degrees of fertility which ranged from 4 to 132% of the original seed. As judged from their seed production, ~10% of all fertile mutants were within the range of the primary form, and would be evolutionally competitive. On the basis of the total number of mutants produced, this fraction was ~2%. The mutants with positive selection value resulted, for the most part, from small mutations, in the sense that this term can be used morphologically and physiologically. The degree of fertility of one early blooming mutant responded specifically to climatic factors. During growth periods with normal rainfall, its seed production was far below that of the parent stock, but in dry years it equalled or exceeded the productivity of the parent stock. For this reason this mutant would be much better

able to survive in a dry climate than the parent stock could. (BBB)

17618 ON THE INFLUENCE OF BLOCKADE OF THE RETICULOENDOTHELIAL SYSTEM BY THOROTRAST ON VIREMIA AND THE DEVELOPMENT OF FOOT-AND-MOUTH DISEASE MYOCARDITIS. Artur Luebke (Bundesforschungsanstalt fur Viruskrankheiten der Tiere, Tübingen, Ger.). Zentr. Veterinaermed., Ser. B, 10: 449-58(Aug. 1963). (In German)

By two intravenous injections of Thorotrast (colloidal ThO_2) a marked blockade of the reticuloendothelial system (RES) was produced in adult mice and the animals then received either at once or 7 days later an intraperitoneal injection of the C_1 strain of foot-and-mouth disease virus, which is markedly pathogenic for adult mice. The blood virus titer of the Thorotrast-treated animals was increased both at the beginning and at the end of the viremia. Whether blockade of the RES produces this temporary change of the blood virus content due to inadequacy of phagocytosis could not be determined. Infection and virus multiplication in the myocardium, as judged by the frequency of myocarditis and mortality, was not influenced by Thorotrast. It is concluded that macrophages of the RES do not play a very important part as phagocytes in the viremia and myocarditis of foot-and-mouth disease. (BBB)

17619 EFFECT OF RADIATION ON THE LEVEL OF ANTIBODIES AND RETENTION OF R. PROWAZEKII IN ANIMALS. Sh. M. Ostrovskaya and A. Kh. Tursunov. Zh. Mikrobiol., Epidemiol. i Immunobiol., No. 12, 121 (1963).

Three groups of guinea pigs infected with R. prowazeki were irradiated with a single dose of x rays as follows: group 1, 400 r, 1-3 months after recovery; group 2, 300 r, 16 days after infection; group 3, 300 r, 3-5 days prior to infection. Infected nonirradiated animals were used for controls. Severe leukopenia appeared in group 1 five to six days after irradiation. However, the agglutinin titers in group 1 were similar to those in the controls. The agglutinin titers remained unchanged in group 2; no specific antibodies or rickettsia were detected. The agglutinin titers were 1 to 2 dilutions higher in group 3 than in the controls and the sera of two animals agglutinated with R. prowazeki in 1:160 and 1:320 dilutions. (OTS)

17620 REVIEW OF THE ARMY FOOD IRRADIATION PROGRAM. Hearing Before the Joint Committee on Atomic Energy, Congress of the United States, Eighty-Eighth Congress, First Session, May 13, 1963. (United States. Congress. Joint Committee on Atomic Energy). May 13, 1963. 546p. $1.50(GPO).

Progress in the Army program is summarized. The most dramatic accomplishment was the approval by the Food and Drug Administration on February 8, 1963, of the Army petition for unrestricted public consumption of Co^{60}-irradiated bacon. This clearance provides a reference standard by which other products can be cleared for human consumption and will accelerate such clearances. A petition for clearance of irradiated white potatoes at sprout inhibition doses was submitted to the Food and Drug Administration on May 3, 1963. The Army plans to submit a petition for clearance of irradiated canned chicken within the next year. Joint Army-AEC petitions will be submitted on irradiated oranges and fruit compote with the AEC providing product development data and the Army providing wholesomeness data. The Army has recently consulted with officials of the Food and Drug Administration regarding submission of an amendment to the bacon petition to include electron irradiation. There is interest on the part of both the Army and a commercial firm to obtain clearance of electron irradiated bacon. This would represent the first request, worldwide, for clearance of electron irradiated foods. Research has shown that certain wholesomeness areas previously thought to be problems have been shown to be unrelated to irradiation of food. These areas are: decreased growth in rats fed irradiated whole orange diet; decreased longevity in rats fed irradiated bacon and fruit compote; and increased spleen weights in dogs fed irradiated green beans and fruit compote. The majority of the wholesomeness program will be completed during the next year with certain studies continuing for another year. The outlook in the wholesomeness program continues to be optimistic. In the field of packaging, efforts have not proceeded as rapidly as originally planned. Major problems in this area include development of a polymeric material which has a tolerable release of extractives, prevention of microbial and insect penetration through the polymers during storage and handling and the prevention of loss of physical protective characteristics of polymers during irradiation and postirradiation handling, transportation, and storage. It is pointed out that the granting of clearances for irradiated foods does not establish commercial feasibility. There still remains the requirement for industry to accept and to build the necessary facilities to fulfill production requirements. (auth)

17621 DEISTVIE IONIZIRUYUSHCHIKH IZLUCHENII NA ORGANIZM. (Effects of Ionizing Radiation on Organisms). Moscow, Publishing House of the Academy of Sciences, 1962. 207p.

Of the twelve papers published in this volume, ten were abstracted separately; two papers were previously abstracted in NSA. (L.T.W.)

For abstracts of individual papers see: 17622, 17623, 17624, 17625, 17626, 17627, 17628, 17629, 17630, and 17671.

17622 RELATIVE RADIATION SENSITIVITY OF OVARIES OF DIFFERENT RODENTS. O. N. Petrova. p.31-66 of "Deistvie Ioniziruyushchikh Izluchenii na Organizm." Moscow, Publishing House of the Academy of Sciences, 1962.

The literature is reviewed (102 references), and work done on irradiation of female guinea pigs, golden hamsters, mice, and rats is described. A single whole-body irradiation interrupted the estral cycle, decreased or destroyed fertility, and caused changes in the ovaries. Mice were the most radiation sensitive, with 50 r causing cessation of the estral cycle. In hamsters, 500 r interrupted the cycle in 6 to 10 months. But guinea pigs after 100 to 200 r showed no interruption after 10 to 24 months. Fertility was more radiation-sensitive than the estral cycle, with 15 to 25 r decreasing the number of progeny in mice, while the estral cycle was not affected at this dose. Ovary weights decreased directly with increasing dose in guinea pigs and with time in mice. In mice, guinea pigs, and hamsters, the number of follicles decreased with increasing dose and time, but in the mice the sharp decrease immediately after irradiation was not accompanied by an immediate decrease in ovary weight. In mice, hamsters, and guinea pigs there was a high positive correlation between the number of follicles and the number of estral cycles, with discontinuance of the cycle being accompanied by complete absence of follicles. In hamsters ovulation stopped and corpora lutea were absent 10 months after 200 r irradiation. In mice, hamsters, and rats young follicles were more radiation sensitive than older ones; the reverse was true in guinea

pigs. Sterilization and mortality resulting from irradiation appeared to be completely independent actions. (TTT)

17623 EFFECTIVENESS OF SINGLE AND REPEATED DOSES OF IONIZING RADIATIONS ON GONADS OF MICE AND RATS. O. N. Kitaeva, N. N. Kuznetsova, and M. D. Pomerantseva. p.67-90 of "Deistvie Ioniziruyushchikh Izluchenii na Organizm." Moscow, Publishing House of the Academy of Sciences, 1962.

Male and female white mice and female white rats about 3 months old were treated with x rays and fast neutrons. With total x irradiations of 100 and 400 r, the effect on mice testicles of single and divided doses was the same. With a total of 1600 r, damage was less with the divided dose. Fast neutrons had considerably more effect than x rays. With a divided total dose of 100 rads for fast neutrons, the degree of damage was the same as with a single dose. The follicular apparatus of mice ovaries was very sensitive to x irradiation; that of rats was relatively resistant. In both mice and rats the young follicles were the most resistant. Two irradiations, at intervals of 2 and 8 days, to a total of 30 r in mice and 100 r in rats decreased the number of follicles in the ovaries less than a single irradiation of the same amount. The fertility of female mice irradiated to 30 r was higher when the dose was divided than when it was single. Tables are given showing the weights of testicles, spleens, and thymuses, the number of ovarian follicles, and the number of mice per litter in the various experiments. 48 references. (TTT)

17624 EFFECT OF PRELIMINARY IRRADIATION IN ALTERING THE EFFECT OF IRRADIATION ON THE ORGANISM. M. D. Pomerantseva, L. K. Ramaiya. p.91-106 "Deistvie Ioniziruyushchikh Izluchenii na Organizm." Moscow, Publishing House of the Academy of Sciences, 1962.

Male mice and rats, 2.5-months old were x-irradiated. Those which had been subjected to a single sublethal irradiation previously showed a higher survival rate. The protective effect was observed with a preliminary dose of 50 to 250 r fourteen days before the test dose of 600 r. The protective effect did not extend to body weight, weights of radiation-sensitive organs, or peripheral blood changes. The factors studied were the weights of the spleens, thymuses, and inguinal lymph nodes; diameters of the adrenals; leucocyte, lymphocyte, neutrophil, and erythrocyte counts; hemoglobin; percentages of reticulocytes; and percentages of mitoses in the bone marrow. During the time of increased radiation resistance, overcompensation in these factors was not observed. A preliminary fractional irradiation did not change the total number of leucocytes or the histological picture of the rat gonads after a second 500-r irradiation. The increased radiation resistance is attributed to a mobilization of the adaptation capabilities of the organism. 50 references. (TTT)

17625 CHANGES IN PERIPHERAL BLOOD OF MICE IRRADIATED DURING EMBRYONIC DEVELOPMENT. N. I. Nuzhdin, N. N. Kuznetsova, and L. K. Ramaiya. p.107-115 of "Deistvie Ioniziruyushchikh Izluchenii na Organizm." Moscow, Publishing House of the Academy of Sciences, 1962.

Female white mice, 2.5 to 3 months old, in their first pregnancies were x-irradiated. The newborn progeny of mice irradiated to 200 r in the thirteenth to nineteenth day of gestation showed changes in the blood typical of radiation sickness. Blood damage was maximum when the irradiation was on the seventeenth day, as shown by the decrease in the number of erythrocytes, amount of hemoglobin, and number of reticulocytes. The blood damage to the newborn was short-lived, being corrected in five to ten days. Irradiation on the twelfth or thirteenth day of pregnancy caused a sharp lag in development, accompanied by leukopenia and anemia until the forty-fifth day of life. The blood changes are attributed to interference with the functioning of the blood-forming organs. Irradiation on the twelfth and thirteenth days is considered to damage the mechanism by which the bone marrow, spleen, and lymph nodes are formed, and that on the seventeenth, the forming bone marrow itself. 13 references. (TTT)

17626 EFFECT OF Co^{60} GAMMA IRRADIATION ON RABBIT GAMETE FERTILIZATION AND EARLY EMBRYOGENIC STAGES. N. I. Nuzhdin and G. V. Nizhnik. p.116-40 of "Deistvie Ioniziruyushchikh Izluchenii na Organizm." Moscow, Publishing House of the Academy of Sciences, 1962.

Pubescent female Chinchilla rabbits were irradiated (Co^{60} source) with 100 to 850 r 1 hr after service by a vazectomized male and were then immediately artificially inseminated with unirradiated sperm. Both fertilization and development of ovulation were decreased by the irradiation. Development of fertilized eggs was slowed, with only 50% reaching the 10 to 20 blastomer stage in 96 hr, while all controls reached the blastocyte stage in this time. The blastomers were quite different from those in the controls. In animals irradiated with 850 r the zygote volume did not increase in the first 4 days of development, while in the controls it increased to $2.7 \times 10^7\ \mu^3$. In the first 3 days the thickness of the hyaline membrane of the irradiated females remained at about 20 μ, but in the controls increased from 22 to 150 μ. The mucin layer was thicker on one side than on the other in the irradiated animals. Both membranes became thinner in the irradiated only after 96 hr but in the controls after 72 hr. Some females were inseminated with sperm irradiated in vitro with 100 to 15,000 r. The young produced decreased to 60% with 100 r, 20% with 300 r, 9% with 800 r, and 0 with 1000 r. Embryo development was interfered with. By the intravital microscopic method used very early cell changes could be observed. 59 references. (TTT)

17627 ACTION OF IONIZING RADIATION ON THE STRUCTURE OF THE ADRENALS AND THE MEDULLA HORMONES. B. M. Graevskaya and R. N. Shchedrina. p.141-56 of "Deistvie Ioniziruyushchikh Izluchenii na Organizm." Moscow, Publishing House of the Academy of Sciences, 1962.

Male white mice, 8 to 10 weeks old, were whole-body irradiated with 600 and 2000 r and sacrificed 2 hr to 8 days later. Studies were also made with local adrenal irradiation and with adrenals screened. Compared to controls, the whole-body irradiated groups at both levels showed loss of both dry weight and total weight of the adrenals for about 50 hr; then the total weight in the 600-r group increased, reaching 40% of that of the controls at the 96th hr. Adrenal sizes changed, especially the cortex, in which cell nuclei became smaller. Cell size also decreased in the medulla. The 600-r dose resulted in decreased adrenalin, accompanied by a significant increase in dehydroadrenalin. At 96 hr after irradiation the free adrenalin increased and dehydroadrenalin practically disappeared. On the eighth day, free adrenalin again decreased and dehydroadrenalin significantly increased. With 2000 r irradiation the adrenalin concentration decreased gradually until the time of death (3 to 4 days after irradiation). Blue-yellow pigments accumulated in the adrenals of the irradiated mice, and chromatographic analysis showed incompletely oxidized chromogens present. The screening experiments indi-

cated that the action on the adrenals is direct. 63 references. (TTT)

17628 SIGNIFICANCE OF THE ADRENAL MEDULLA HORMONES IN THE INTERRUPTION OF CARBOHYDRATE METABOLISM CAUSED BY IONIZING RADIATION. B. M. Graevskaya. p.157-61 of "Deistvie Ioniziruyushchikh Izluchenii na Organizm." Moscow, Publishing House of the Academy of Sciences, 1962.

Data are presented which confirm the disturbance of carbohydrate metabolism by ionizing radiation, as described in the literature. Male white mice, 26 to 28 g, 2 to 2.5 months old, were irradiated with doses of 600 and 2000 r of x rays and decapitated 2 to 96 hr later. Blood sugar, liver glycogen, and adrenalin were determined. With the lower radiation dose, the liver glycogen changed little the first two days but sharply decreased after that. With the higher radiation dose, the liver glycogen increased markedly the first two days and then tended to decrease, with the animals dying on the fourth day. There was a clearly shown inverse correlation between the liver glycogen and total adrenalin in the adrenals, indicating that the radiation-induced change in blood adrenalin actually affects the liver glycogen. Administration to normal mice of homogenate of irradiated mouse adrenals did not change the carbohydrate metabolism picture, which was observed in administration of adrenalin or normal adrenal homogenate. Irradiation of adrenalectomized mice had little effect on the liver glycogen content. These results are not in agreement with some conclusions published earlier by the same author. 30 references. (TTT)

17629 TRANSMISSION OF REMOTE ACTION OF IONIZING RADIATION. O. P. Domareva. p.162-6 of "Deistvie Ioniziruyushchikh Izluchenii na Organizm." Moscow, Publishing House of the Academy of Sciences, 1962.

Two groups of male mice, two to three months old, were irradiated with 600 r, the heads and adrenals being screened in one group and only the heads screened in the other. Values for corneal mitosis were about the same in the two groups, both somewhat less than in the controls. In another series of experiments, adrenalectomized mice irradiated similarly showed no difference in corneal mitotic activity from their controls. Corneal activity was measured in material fixed in alcohol-acetic acid 2 hr after irradiation, a time that had been shown earlier to be a time of marked decrease in such activity. In the case of the adrenalectomized series, the mitotic activity determined after 6 hr showed a definite increase in both control and irradiated mice. This may be explained by the absence of an inhibiting effect of the adrenals. The mitotic activity was measured in units of number of mitoses seen in 100 microscope fields. Actual values in the first series were 247, 278, and 365 for the screened head and adrenals, screened head only, and controls; in the second series, irradiated and non-irradiated values were 143 and 151 for the adrenalectomized mice and 106 and 204 for intact mice after 2 hr, and 250, 242, 143, and 136 after 6 hr. 40 references. (TTT)

17630 SOME PHYSIOLOGICAL AND BIOCHEMICAL CHARACTERISTICS OF MICE STRAINS AND THEIR RELATION TO DIFFERENCES IN RADIATION SENSITIVITY. N. I. Nuzhdin, I. A. Nechaev, B. M. Graevskaya, R. N. Shchedrina. p.167-72 of "Deistvie Ioniziruyushchikh Izluchenii na Organizm." Moscow, Publishing House of the Academy of Sciences, 1962.

Male mice from four different strains with different radiation sensitivities were compared morphologically and biochemically. Their ages were 2.5 months ± 7 days, and their body weights were about 25 g. By irradiation with 350 to 650 r, $LD_{50/30}$ values were established as 563, 536, 457, and 442 r for the groups. The resistant strains (the first two) in comparison with the sensitive strains had higher weights of the liver, spleen, and thymus, higher catecholamine content in the adrenals, and lower liver glycogen. No correlation of adrenal and testicle weights with radiation sensitivity appeared. Catecholamine was also studied in two subgroups of one strain, with considerable difference in its value. This material was determined both histochemically and biochemically. The marked correlation between liver glycogen and radiation sensitivity is suggested as secondary, being considered dependent on the adrenal catecholamine level. 25 references. (TTT)

Radiation Effects Therapy and Countermeasures

17631 (ANL-6790(p.87-91)) PROGRESS REPORT: PLUTONIUM REMOVAL, TUMOR INCIDENCE STUDIES. [PART] IV. Marcia W. Rosenthal, Joan F. Markley, and Arthur Lindenbaum (Argonne National Lab., Ill.).

Preliminary data suggest that after the administration of monomeric Pu to mice, bone tumors appear earlier and more frequently than after the administration of the polymeric form of Pu. Preliminary results also suggest that the removal of half of the monomeric Pu from bone by DTPA therapy at 3 days does not reduce tumor incidence by 50%, as is the case with polymeric Pu. At 400 days the group of mice injected with monomeric Pu and treated with DTPA at 1 hr had about the same survival (85%) as that of the control group receiving only DTPA (90%). (C.H.)

17632 (ANL-6790(p.97-100)) EXTRACTION OF DNA AND RNA FROM RADIOSENSITIVE AMOEBAE AND THE USE OF THESE COMPOUNDS IN RADIORESTORATION AND TRANSPLANTATION EXPERIMENTS. Edward W. Daniels, Evelyn P. Brown, and Anna K. Laird (Argonne National Lab., Ill.).

The injection of concentrated DNA or RNA from unirradiated donor amoeba had no effect on the recovery of lethally irradiated amoeba of the same species. Pelomyxa carolinensis were found to grow and multiply after the injection of either DNA or RNA from Pelomyxa illinoisensis. (C.H.)

17633 (ANL-6790(p.150-5)) FRAGILITY STUDIES OF RAT SPLEEN LYSOSOMES AFTER X-IRRADIATION. Y. E. Rahman (Argonne National Lab., Ill.).

Mechanisms involved in physical or chemical changes induced by radiation in the membranes of rat spleen lysosomes were studied. Data are included on the sensitivity of lysosomes in irradiated spleen homogenates to detergent, sucrose, and pH. The effects of adrenalectomy, thyroidectomy, and thyroid hormones on spleen lysosomes were studied in irradiated intact rats. Results indicate a relation between changes in spleen lysosome membranes and thyroid hormones. (C.H.)

17634 (EUR-484.e) BONE MARROW TRANSPLANTATION AFTER WHOLE-BODY IRRADIATION. AN EXPERIMENTAL STUDY IN THE RAT. H. Balner (Netherlands. Gezondheidsorganisatie, TNO. Radiobiologisch Instituut, Rijswijk). 1963. 133p.

Thesis submitted to Universiteit, Amsterdam.

Rats were treated with homologous bone marrow following high sublethal and lethal radiation doses. The majority of the animals survived beyond four weeks after irradiation with a functioning donor-type hemopoietic tissue. There

was no evidence of a so-called median-lethal-dose-effect. Secondary disease occurred during the second and third month following irradiation and homologous bone marrow therapy. Morbidity and mortality were variable but generally rather low, respectively about 30 and 15%. The clinical and pathological findings were reminiscent of those described for mice with secondary disease except that colitis and diarrhea were not observed. In a limited number of animals temporary chimerism was shown to be associated with persistence of specific tolerance towards the antigens of the former bone marrow graft. The rat chimeras showed a considerable reduction of longevity as compared with controls. Cataract was consistently found, nephrosclerosis was frequently encountered. Infectious complications were comparatively rare except in the urogenital tract. The incidence of benign and malignant tumors was high. Clinical applications of homologous and autologous bone marrow therapy are briefly reviewed and some of the problems, encountered both in experimental and clinical transplantation of hemopoietic tissues, are discussed. The usefulness and the limitations of the information gathered from experiments on animals are discussed. (auth)

17635 (TID-20443) THE APPLICATION OF CLONED HAEMOPOIETIC CELLS IN RADIATION PROTECTION. Progress Report No. 1. Michael Feldman (Weizmann Inst. of Science, Rehovoth, Israel). Dec. 10, 1963. Contract IAEA 196/US. 3p.

Cellular and functional properties of clones of bone marrow and spleen cells produced in lethally irradiated mice were analyzed. It was found that such clones are segregated into two cellular types: erythropoietic and granulocytic. The possible occurrence of neoplastic transformations in serial sub-clonization was also examined. A second aspect of this study was concerned with testing the ability of primary clones to confer protection on secondary lethally irradiated mice. Experiments done in isologous systems clearly demonstrate radioprotective qualities. (H.M.G.)

17636 LEUKOKINETICS IN DOGS GIVEN SUPRALETHAL IRRADIATION WITH OR WITHOUT A GRAFT OF MARROW. E. D. Thomas, G. L. Plain, J. A. Cavins, and D. A. Blumenstock (Mary Imogene Bassett Hospital, Cooperstown, N. Y.). Ann. N. Y. Acad. Sci., 113: 1020-32 (Feb. 28, 1964).

Dogs given whole-body irradiation and an infusion of compatible marrow cells showed a rapid recovery of leukocytes. During the recovery, a semi-log. plot of white-blood-cell count gave a straight line with a doubling time of 26 hr. By extrapolating this line back to the time of infusion, it was calculated that there was about one myeloid stem-cell for each 190 nucleated marrow cells administered. The dog who was without white cells as a result of prior irradiation was used as a leukocyte sponge in cross-circulation studies. The donor dog was found to be able to mobilize up to about 9×10^9 polymorphonuclear leukocytes and band forms/kg. in 12–18 hr. when cross-circulated with a succession of irradiated sponge recipients. In dogs exposed to 750 or 1500 r, the half-time of disappearance of leukocytes was found to be 13 hr. This disappearance rate accounted for a loss of 5.5×10^9 leukocytes/kg of dog from leukocytes circulating in the peripheral blood. An additional number of leukocytes, approximately 4.5×10^9/kg, disappeared in the marrow without passage through the blood. These leukocytes could be mobilized rapidly on demand by cross-circulation or infection. Repeated cross-circulation with a normal dog was successful in maintaining the leukocyte level of a lethally irradiated dog. Long-term maintenance of lethally irradiated dogs by this technique was unsatisfactory because of local infection associated with frequent operations and because of pneumonia maintenance of lethally irradiated dogs by this technique was unsatisfactory because of local infection associated with frequent operations and because of pneumonia associated with repeated general anesthesias. (auth)

17637 THE INFLUENCE OF THYROXINE AND METHYLENE BLUE ON THE INDIRECT RADIATION EFFECT IN CHICK EMBRYOS. E. Wendt (Kernforschungsanlage, Jülich, Ger.). Atompraxis, 10: 114-18(Feb. 1964). (In German)

Experimental results show that the indirect radiation effect in six-day-old Leghorn embryos is strengthened if the animals' metabolism is accelerated by pre-treatment with the thyroid hormone thyroxin. In contrast, an artificial depression of metabolism by means of methylene blue causes a weakening of the indirect radiation effect. These findings are in agreement with the view that the survival time of totally irradiated animals is inversely proportional to their metabolic activity. (auth)

17638 EFFECTS OF 6-AZAURIDINE ON REGENERATING BONE MARROW. J. W. Hollingsworth (Yale Univ., New Haven and Veterans Administration Hospital, West Haven, Conn.). Biochem. Pharmacol., 13: 401-6(Mar. 1964).

The pyrimidine nucleoside antimetabolite, 6-azauridine (AzUR), was studied for its effect on the regeneration of bone marrow in heavily irradiated mice with marrow repopulated by transfusion of isologous marrow cells. AzUR, a drug that has antitumor activity, but relatively little toxicity for normal bone marrow in mice, suppressed marrow regeneration when given at 8-hr intervals for a week in total daily doses of 10-620 mg/kg, or when administered in a single large dose, 1,000 or 3,000 mg/kg, on the fourth day after irradiation and seeding with isologous marrow cells—a time when the cells appear particularly sensitive to cytotoxic agents. The observations indicate that the marrow precursor cells behave in a manner resembling that of certain types of neoplastic cells in their responsiveness to drugs, and support the earlier suggestion that the regenerating marrow system can be of value in detecting drugs with antitumor potential. (auth)

17639 THE PROTECTIVE EFFECTS OF CYSTEAMINE AGAINST IONIZING RADIATION IN MOUSE FIBROBLASTS GROWING IN VITRO. J. D. Gaines, C. B. Harbury, L. Aronow, and R. F. Kallman (Stanford Univ., Palo Alto, Calif.). Biochem. Pharmacol., 13: 545-8(Mar. 1964).

Experiments, using the parameter of population growth of L-strain mouse fibroblasts after irradiation in the presence of different concentrations of the agent, were undertaken in an attempt to determine whether MEA exerts a radioprotective effect. The results confirm the radioprotective action of cysteamine on a representative mammalian cell in vitro. (P.C.H.)

17640 BONE MARROW TREATMENT OF MICE LETHALLY IRRADIATED WITH GAMMA-RAYS UNDER HIGH DOSE RATE. V. THE LONG TERM PRESERVATION OF BONE MARROW AT −80°C. Masaharu Hama, Kazushige Adachi, Morihisa Yamagishi, Haruto Uchino, and Gyoichi Wakisaka (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 42: 56-62(Jan. 1964).

Isologous bone marrow that had been kept in glycerol-Tyrode's solution at −80°C as long as 270 days protected lethally gamma irradiated mice as well as the fresh IBM transplantation did, as far as 5 million of nucleated cells

were injected. The homologous bone marrow preserved as long as 90 days gave higher 21 days survival rates than those in the fresh HBM transplantation, as far as 5 million of nucleated cells were injected, and furthermore postponed the development of the secondary diseases as compared to the fresh HBM transplantation. The HBM that had been preserved more than 90 days and given in doses of 5 million nucleated cells, however, could not protect the lethally irradiated mice. When the number of the nucleated cells that were preserved and transplanted was increased up to 10 million, good early survival rates were observed in 120 and 180 days preserved HBM transplantation. The supposed reasons for this favorable effect by freezing are discussed. (auth)

17641 BONE MARROW TREATMENT OF MICE LETHALLY IRRADIATED WITH GAMMA-RAYS UNDER HIGH DOSE RATE. VI. APPLICATION OF ANTIFOLIC "METHOTREXATE" FOR SUPPRESSION OF IMMUNE RESPONSE. Kazushige Adachi, Masaharu Hama, Morihisa Yamagishi, Haruto Uchino, and Gyoichi Wakisaka (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 42: 63-7 (Jan. 1964).

The early administration of folic acid antagonist, Methotrexate, for lethally gamma irradiated mice treated with HBM was highly effective for the suppression against the development of the homologous disease, but its effect was still less than that of the IBM treatment. The early administration of Methotrexate for the lethally gamma irradiated mice treated with the homologous spleen cells was not effective enough for the suppression of the homologous disease. The probable mechanism as to the suppression of the immune response by the administration of Methotrexate is discussed. (auth)

17642 PLASTIC SURGERY OF RADIONECROSIS. E. F. Malbec and J. V. Quaife. Dia Med. (Buenos Aires), 34: 2235-8(Nov. 12, 1962. (In Spanish)

Surgical procedures are described. (BBB)

17643 CHANGES IN INTESTINAL MOTOR FUNCTIONS AFTER OVERALL X-RAY IRRADIATION AND APPLICATION OF SOME PROTECTIVE AGENTS. I. Ya. Nekachalova (Inst. of Experimental Medicine, Leningrad). Farmakol. i Toksikol., 26: 327-33(1963). (In Russian)

A detailed inquiry into the motor function of the small intestine in radiation injuries, which was set as an object of the investigation, is a matter of considerable interest, since it is already within the first hours after x irradiation that the lesion of the gastrointestinal tract and deranged intestinal motor function become evident. In addition, the motor function of the intestine was looked into following application of mercamine, vitamins C and P, as well as tannin, because these agents are known to produce a protective effect on the animal body in penetrating radiation injuries. Experiments were performed on dogs with Thiry-Wella's fistulae of the large and small intestines. In order to take recordings of the intestinal motor function a hollow cylinder, connected with a small drum through a rummer tube, was inserted into an isolated portion of the intestine, 25 cm long. Once the normal, usual motoricity was obtained, this serving as a background, the animals were exposed to a total-body irradiation, effected from two x ray units without tubuli, at a focal distance of 1 m and potential of 180 kv. Current intensity was 15 ma and the filter was 0.5 mm of Cu. Doses actually dispensed were 250 and 500 r. Conclusions reached were as follows: in a total-body x irradiation of dogs the resultant considerable disturbances of the intestinal motor functions are liable to continue for a long time. These derangements set in both at irradiation doses of 250 and 500 r and occur in various segments of the intestine, but are more marked with the latter dose. Prophylactic introduction of cysteinamine exerts some influence upon the motoricity of the small intestine, easing the peristalsis, decelerating contractions and bringing them to the normal level. A preliminary introduction of vitamins C and P into the isolated portion of the intestine likewise affects positively the motor function of the intestine, tending to restore it. Irrigation of the isolated portion of an intestine with a 0.5% tannin solution tends to substantially deteriorate the intestinal motoricity both prior to and after irradiation. (auth)

17644 THE ROLE OF INTESTINAL BACTERIA IN THE RECOVERY FROM WHOLE-BODY RADIATION. Chester B. Rosoff (Beth Israel Hospital, Boston). J. Exptl. Med., 6: 935-43(Dec. 1, 1963).

Female Wistar rats were exposed to 325- to 675-r, single doses of x rays at a rate of 17 r/min after daily oral antibiotic treatments. The nonabsorbable antibiotics, neomycin sulfate or polymyxin B, prevented death from an otherwise lethal dose of whole-body radiation by suppressing the activity of the gram-negative bacterial flora of the intestinal tract. The protective effect of such suppression was evaluated over the entire range of radiation exposure. Coliform-free animals uniformly survived exposure to 550 r, a dose which is regularly lethal for coliform-bearing animals. When antibiotic treatment is begun within 1 hr after 550-r whole-body radiation, survival is the rule. Delay in starting treatment is critical, for the longer the delay, the higher the mortality, even though the stool cultures meanwhile become coliform-free. When antibiotic is started prior to or immediately after radiation exposure, it must be continued for at least 3 weeks for maximum effectiveness. The shorter the postirradiation period of treatment, the greater the mortality. This suggests that the defense systems involved require protection for at least 3 weeks in order to permit return of maximal function. The nonabsorbable intestinal antibiotics are effective only when cultural data demonstrate successful elimination of the coliform flora in the gut. Since prevention of bacteremia alone does not prevent death, and since survival hinges on the elimination of the intraintestinal gram-negative bacteria, an essential constituent in the lethal process must be the effect of bacterial activity within the gut. This suggests that the products of such bacterial activity, when absorbed, are not detoxified because of radiation injury to the defense mechanism, and thus cause additional damage to the animal. This explains why previous workers have not been able to demonstrate consistent results when antibiotics were used either before, or as treatment after, radiation injury. In these earlier studies, agents were given parenterally to control bacteremia and infection. The limited success of such therapy is explained by the present data showing that absorbed products of intestinal bacterial activity, rather than invasion and infection, are responsible for the lethal outcome. Hence, the conclusion is drawn that the vulnerability of the unprotected, irradiated animal lies in its reduced capacity to detoxify absorbed products of intestinal bacterial growth, a disorder which is reversible if appropriate protection is provided. (BBB)

17645 STUDY ON THE EFFECT OF THE SO-CALLED HEAVY METAL DRUGS ADMINISTERED SIMULTANEOUSLY WITH IRRADIATION OF Co^{60} ON EXPERIMENTAL TUMORS. Hayami Fujimori and Sadao Teramura (Osaka City Univ.). J. Japan Obstet. Gynecol. Soc., 7: 75-86(Apr. 1960).

Various compounds were injected in tumor-bearing mice before and after irradiation with ^{60}Co γ rays. Ehrlich as-

cites carcinoma cells were implanted in NA2 male mice which were irradiated with 937- or 1171-r doses of γ radiation. The compounds tested were aurothioglucose, arsenobenzene, bismuth trichlorobutyl malonate, and colloidal silver. Tumor growth was inhibited by prior injection of the heavy metal compounds, the tumor size remaining the same or diminishing 10 to 20 days after treatment, while a 50 to 75% increase in tumor size occurred in untreated mice. The metals injected after irradiation were much less effective, and given in the absence of irradiation did not appreciably affect tumor size. All of the compounds tested were similarly effective. It was noted that the compounds exerted an appreciable effect even when injected after irradiation. Cytologic studies demonstrated mitotic inhibition in cells of mice pretreated and irradiated; this inhibition was maximum 12 hr post-treatment. The number of cells in metaphase increased and that of cells in telophase decreased. Various compounds had similar effects, with arsenobenzene being slightly more effective in inhibiting mitoses than the others. Phase-contrast microscopic studies demonstrated destruction of nuclei of tumor cells and cytoplasmic vacuolation after combined heavy metal-radiation treatment. It is suggested that secondary radiations from the irradiated metals present in tumor tissue were effective in producing lethal effects in the cancer cells. Effects produced in nontumor cells did not appear to be involved in the radiosensitizing effects of the metal compounds. (BBB)

17646 FUNCTIONAL STUDIES ON THE FIBROUS MATRIX OF CUTANEOUS CONNECTIVE TISSUE AND OF THE AORTIC INTIMA BEFORE AND AFTER ROENTGEN IRRADIATION. R. Brinkman (Rijksuniversiteit, Groningen, Netherlands). Jaab. Kankeronderz. Ned., 11: 145-8(1961). (In Dutch)

When rat skin was irradiated with doses of 50 r and higher higher of 60-kv x rays, an increase in the permeability of the corium to water was demonstrable. Similar increases in the permeability of bovine aorta to water following irradiation in vitro were noted. In both cases an injection of saline into the connective tissue was made, the increased permeability being measured by the drop in pressure of the injected fluid. This increase of permeability could be prevented by prior treatment with sodium thiosulfate, cystamine, serotonin, and AET. It is suggested that the observed disruption of the connective tissue barrier results from the radioinduced depolymerization of mucopolysaccharides. (BBB)

17647 STUDIES ON RADIOACTIVE CESIUM. III. A HISTOPATHOLOGICAL STUDY ON INJURIES CAUSED BY Cs^{137} IN ORGANS OF THE MOUSE, PARTICULARLY IN TESTIS. Kaisuke Kameta, Kenshi Katayama, and Tuyoshi Kiyota (Kumamoto Univ., Japan). Kumamoto Med. J., 15: 90-1(1962).

In mice injected subcutaneously with 0.05, 0.2, or 1.0 μC ^{137}Cs, no marked pathologic change was observed in kidney and spleen. On the other hand, atrophy and pyknosis were noticed in liver cells. In the testis, which has a strong affinity for ^{137}Cs, there was not only a numerical decrease of spermia and germ cells but also atrophy, pyknosis, and necrosis of the latter. Such injuries became more serious with time and were most marked in spermatogonia, followed by spermatocytes, spermatids, and spermia. Spermatids and spermia showed only slight changes. The histopathological changes were closely parallel to the doses of ^{137}Cs administered. In regard to the group treated with deoxycorticosterone acetate (DOCA), cortisone, or CsCl, no significant difference was found on the 8th day after the injection in comparison with the control. On the 20th day, however, the pathologic changes of the treated animals were less than those of the controls. Among the treatments used, no marked difference was found in the degree of reduction of injury. It is noteworthy that marked changes were found in liver cells of mice treated with DOCA for three days consecutively, and that all the mice died during the course of experiment. The result is inconsistent with the previous finding that the deposition of ^{137}Cs can be prevented by this drug. It may be interpreted as a consequence of the intoxication by overdosage of DOCA. DOCA, cortisone, and CsCl are regarded as highly effective agents for removing ^{137}Cs in vivo, provided that the dose and the term of administration are appropriate. (BBB)

17648 EFFECTS OF ULTRAVIOLET THERAPY ON THE SURVIVAL OF X-IRRADIATED MICE. Kalman Rak, Ferenc Krizsa, Ervin Sovenyi, and Istvan Cserhati (Orvostudomanyi Egyetem I. Belklinika, Szeged). Magy. Radiol., 14: 48-51(1962). (In Hungarian)

Tests were made to determine the effects of uv treatment on the survival of mice irradiated with various whole-body doses of 180-kv x rays. Twenty-g mice were treated with a Hanau quartz lamp for 30 min (210 v, 5.2 amp, 50 cm distance). Mice living 30 days after x irradiation were considered having survived the treatment. In the first group of mice singly exposed, the thrombocyte count rose 90% on the 5th day post-uv treatment, whereas a 300-r whole-body dose of x irradiation decreased the thrombocyte count by 61% on the 10th day postirradiation. However, if uv treatment preceded x irradiation by 24 hr, a 21% rise in the thrombocyte count was noted on the 10th day. The rate of survival of x-irradiated mice was compared with that of those having received uv treatment 24 to 48 hr prior to x irradiation, with the following results. At 500-r whole-body irradiation doses, 27% of the mice survived after 30 days, whereas uv-treated mice showed a 57% rate of survival. At 550-r only 9% of the control group survived as opposed to 23% of the group which received the combined treatment. At 600-r none of the control group survived, and 19% of the uv-treated group lived. The average survival time after x-ray treatment was also improved by uv treatment as follows: at 500-r the control group survived 16 days, the x-ray + uv-treated group 20.2 days; at 550-r, 8.6 and 14.5 days; at 600-r, 6.7 and 12.8 days, giving a total average survival time of 10.4 days for the control group, as against 15.7 days for the group receiving the combined treatment. It is suggested that the uv treatment liberates serotonin into the blood which exerts a protective action, although it is known that when serotonin is administered it raises the thrombocyte count within hours rather than the observed 24 to 48-hr period presumably effected by the uv treatment. Further study is necessary to determine the optimal time for uv treatment to act as a protectant against x irradiation. (BBB)

17649 EFFECT OF PRE-TREATMENT WITH THROMBOPOIETIC-ACTIVE HUMAN SERUM ON THE SURVIVAL OF X-RAY TREATED MICE. Kalman Rak, Ferenc Krizsa, Ervin Sovenyi, and Istvan Cserhati (Orvostudományi Egyetem I. Belklinika, Szeged). Magy. Radiol., 15: 99-101 (1963). (In Hungarian)

Attempts were made to determine the effects of human serum with elevated thrombopoietic activity on the survival of mice exposed to 550-r whole-body x irradiation. For this, 120 mice were divided into three groups, each of which were injected with serums with high thrombopoietic activity from three patients (the first two with chronic erythromyelosis and the third with cirrhosis and spleno-

megaly). In each group, half of the mice received human serum from hematologically normal patients, and the other half were injected intraperitoneally with pathologic serum with high thrombopoietic activity. The controls (radiation + normal serum) showed an average 30-day death rate of 95%; the treated group, however, showed an average death rate of 68% after 30 days. The individual results with the three different pathological serums were as follows: pretreated mice showed a death rate after 30 days of 35%, 75%, and 95%, respectively, compared with death rates of the control (normal serum) groups of 85%, 100%, and 100%. The average days survived were 22.5, 11.7, and 8.0 in the treated groups, and 13.3, 6.9, and 6.4 in the control groups. The average thrombocyte counts in the surviving mice were as follows: after 8 days, 110,000 in the treated group, and 59,000 in the control gourp; 10 days postirradiation 280,000 in the treated group and 110,000 in the control group; 20 days postirradiation were 706,000 and 350,000, respectively. Obviously the animals treated with thrombopoiesis-active sera showed greater recovery after irradiation than the control animals. Various possible theories for this phenomenon are discussed, and it is suggested that the human thrombopoietic factor stimulated maturation of stem cells toward development of megakaryoblasts, resulting in greater regenerative capacity of the thrombopoietic system. Thrombopoietically active plasma also raised temporarily the thrombocyte count of a patient suffering from thrombocytopenia associated with the Werlhof syndrome, indicating the therapeutic value of this plasma. (BBB)

17650 RADIATION SICKNESS ASSOCIATED WITH INTERNAL IRRADIATION: CASE REPORT. E. I. Safronov. Med. Radiol., 9: No. 2, 64-71(Feb. 1964). (In Russian)

Description is given of a case of radiation sickness due to internal irradiation resulting from ingestion of radium bromide ($RaBr_2$) in a dose of 2.03 millicurie; simultaneously the patient took luminal perorally. During the first month the patient developed a typical radiation reaction to the effect of radium, later the course of the disease became chronic; the earliest, marked and stable signs were blood changes: leukopenia (2,000), thrombocytopenia (80,000–120,000), accelerated ESR (25–30). A complex of curative and preventive measures, including those for the elimination of radium, were employed. 32 months after acute poisoning the state of the patient is satisfactory, although nearly 90 μC of ^{226}Ra is still present in the organism. (auth)

17651 SERUM PROPHYLAXIS AND TREATMENT OF BACTERIAL INTOXICATIONS IN IRRADIATED ANIMALS. D. R. Kaulen and T. I. Bulatova (Gamalein Inst. of Epidemiology, Academy of Sciences, USSR). Med. Radiol., 9: No. 2, 80-5(Feb. 1964). (In Russian)

The investigation was made on the effectiveness of serum prophylaxis and treatment of bacterial toxins. The effectiveness of seroprophylaxis decreases 1½–4 times depending upon the severity of radiation sickness and routes of introduction of the A type botulin toxin. The decrease is greatest in peroral administration of the toxin. The efficacy of serotherapy of botulin intoxication in irradiated (550 r) mice diminishes even more drastically. In intravenous administration of the toxin 50% of irradiated animals can be saved by the introduction of 1,070 times greater quantity of antitoxin than in the control group. In peroral toxin administration the quantity of the antitoxin necessary is 28 times greater. Transplantation of myeloid cells to lethally irradiated guinea pigs increases 1.4 times the effectiveness of seroprophylaxis of diphtheria intoxication. In irradiated (625 r) guinea pigs treated by bone marrow cell transplantation the capacity to reproduce a passive immunity is practically restored 20 days after the irradiation. (auth)

17652 STUDY ON THE BEHAVIOR OF DEHYDROGENASE ACTIVITY BEFORE AND AFTER SULFUROUS INHALATIONS, IN EXPERIMENTAL PHARYNGITIS INDUCED BY X RAYS. L. Marcucci (Università, Parma, Italy). Minerva Otorinolaringol., 11: 62-5(Feb. 1961). (In Italian)

Changes in the active sulfhydryl groups in enzymes were investigated in relation to the effects of x-ray doses capable of consistently inducing morphologic and functional cellular changes. The mechanism by which functional injuries of the oral mucosa occur under the effects of ionizing radiation was assumed to involve the formation of disulfide bonds from sulfhydryl groups by H_2O_2 and OH and O_2H radicals produced from water. This suggests the possibility of complete or partial reversibility of these injuries by inhalation crenotherapy with sulfurous mineral waters with a high sulfhydrometric value (high H_2S content). Quantitative determination of dehydrogenase activity in the tissues was made by a method involving acetone extraction of the formazan formed from TTC (2,3,5-tri-phenyltetrazole hydrochloride). Photometric measurements were made on enzyme activities in samples from mucosa from the palate, tongue, posterior wall of the pharynx, and cheek, in four groups of 15 guinea pigs each: controls; animals receiving sulfurous inhalation therapy, 15 applications of 15-min inhalations; irradiated (total of 1500 r over 10 days) animals; and irradiated animals receiving sulfurous inhalation therapy. Inhalation of mineral water vapor diminished the inactivation of oral mucosal dehydrogenase caused by irradiation. It is concluded that the ease of oxidation of enzyme-active sulfhydryl groups by intracellular ionization products is thus demonstrated. It is thus possible to alleviate the unpleasant side-effects of x irradiation of the oral mucous membrane. (BBB)

17653 RESEARCH ON GLUTAMIC-OXALACETIC AND GLUTAMIC-PYRUVIC TRANSAMINASES IN CHILDREN SUBJECTED TO ROENTGEN THERAPY. A. Balocco (Università, Turin). Minerva Pediat., 14: 690-6(June 16, 1962). (In Italian)

The first group of 5 subjects ranging in age from 14 days to 5½ months, affected with thymus hypertrophy, were treated with 10 doses of 50 r each. A second group, aged 3½ to 6 yr, included one case of malignant lymphogranuloma, one case of mediastinal lymphosarcoma, and one case of Hand-Schuller-Christain disease; the first two received 10 doses of 200 r each; the last, 15 doses of 200 r. The colorimetric method of Friedman and Hangen, modified by Sigma and Frankel was used to determine pyruvic acid. In the first group, and increase in glutamic-oxalacetic transaminase (GOT) after the first two doses was observed; it then decreases. At 200 r, GOT concentration rises but falls at 250 r; another cycle begins and it falls at 400 r. At the end of treatment the GOT activity is slightly higher than initially (65.75 U/ml average). There is little variation of glutamic-pyruvic transaminase (GPT) on irradiation; little fluctuation was noted and the final value was 37.5 U/ml (initial, 33.58 U/ml). The GOT/GPT ratio is of no significance; in one patient it was inverted after 200 r. The patient with malignant lymphogranuloma had increase in GOT to 400 r (57 U/ml; initial, 33 U/ml), and another at 800 r; GPT increased slowly to 800 r (at this stage the laterocervical mass had nearly disappeared). The case of mediastinal lymphosarcoma had maximum GOT at 600 r (64 U/ml); the final value was higher than the initial. GPT varied between 18 and 30 and paralleled GOT. In the patient with Hand-Schuller-Christian disease, initial GOT activity was

46; first maximum (1400 r) 84; second (2400) 90; final 55. GPT parallels GOT through the first maximum, but there is no second maximum. The greater increase is thus in GOT, accompanied by clinical improvement, and this enzyme may be used for prognosis during roentgen therapy. (BBB)

17654 DEVELOPMENT OF TOLERANCE TO X RADIATION BY OZONE INHALATION IN MICE. Tsuyoshi Sunada, Keiko Hattori, Norio Kato, Masahiro Kinoshita, and Shosaku Kinoshita (Radiation Center of Osaka Prefecture, Osaka). Nippon Eiseigaku Zasshi, 18: 268-72 (Aug. 1963). (In Japanese)

Tolerance to x radiation was rapidly developed (within 24 hr) by subjecting previously irradiated mice to 1 ppm of ozone for 1 hr. The dose reduction factor at LD_{50} was about 1.3. This tolerance lasted for at least 10 days and disappeared at about the 50th day after exposure to ozone. The pretreated animals showed no significant changes in body weight and blood cell counts, and could swim for as long as controls. Thus, this radiotolerance has the advantages of rapid development, long duration, and good preservation of physical strength. It is emphasized that such radiobiologic protection differs from the action of most of radiobiologic protectants reported in the past which are effective only when they are given during or just before irradiation, or when given in nearly toxic doses. The use of ozone represents a homeopathic approach to radioprotection since ozone is a radiomimetic agent. (BBB)

17655 CHEMICAL PROTECTION OF MEG AGAINST IONIZING RADIATION. REPORT III. RELATIONSHIP BETWEEN TIME INTERVAL FROM ADMINISTRATION OF MEG TO IRRADIATION AND PROTECTIVE EFFECT. Shigetoshi Antoku (Hiroshima Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 809-13(Oct. 1963).

MEG was injected in mice at varying time intervals before total body irradiation of 800 to 1000 r for a duration of ~1 min. MEG provided ~ equal protection when administered from 5 to 30 min before irradiation, but it was less effective when the time interval was 60 min. When injected 90 min before irradiation, the survival rate of injected mice was the same as that of unprotected mice, and the average length of survival of the injected mice after irradiation was slightly reduced. (from NSA of Japan)

17656 CHEMICAL PROTECTION OF MEG AGAINST IONIZING RADIATION. REPORT IV. COMPARATIVE PROTECTIVE EFFECTS OF MEG AGAINST FAST NEUTRON AND X-RAY IRRADIATION IN MICE. Shigetoshi Antoku (Hiroshima Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 935-40(Nov. 1963).

MEG significantly modified the bone marrow counts, ^{59}Fe uptake in peripheral blood, and spleen weight of mice exposed to 200 rad of x radiation. Significant differences were observed in these indices between protected and unprotected mice on the 3rd day after irradiation. In neutron irradiated mice, the depression of all these indices was less severe and recovery was earlier, but the protective effect of MEG was not as significant as that in mice exposed to x radiation. (from NSA of Japan)

17657 EFFECTS OF LEYK FOR ROENTGEN DAMAGE IN MICE. Haruo Ezaki and Hiroaki Funaoka (Hiroshima Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1962-7 (Dec. 1963). (In Japanese)

The protective and restorative effects of Leyk, a cysteine derivative, against x radiation damage in mice were studied. Administration of Leyk produced an increase in body weight and in leucocyte counts, but the second effect lasted no more than 10 days. No cases of leucocytosis were caused by Leyk. Among mice given 10 doses of 50 r/day, Leyk administered on the first day of irradiation provided sufficient protective effects, but it had little restorative effect when started 6 or more days after irradiation. Among mice given one dose of 450 r, best results were obtained when Leyk was given on the date of irradiation. In mice receiving one dose of 650 r, few restorative effects were observed, but remarkable protective effects were obtained when Leyk was given continuously 5 or 10 days before exposure. (from NSA of Japan)

17658 INDUCTION OF LEUKEMIA BY X RAY IRRADIATION, ADMINISTRATION OF ESTROGEN, AND THYMUS TRANSPLANTATION IN F_1 HYBRID MICE: A JAX AND AKR CROSS. Kazuya Nakakuki and Yasuaki Nishizuka (Mie Prefectural Univ., Tsu, Japan). Nippon Ketsueki Gakkai Zasshi, 25: 786-93(Dec. 1962).

The mice studied were female F_1 hybrids obtained by crossing females of A/Jax strain and males of AKR strain. AKR mice harbor a leukemia virus. A/Jax mice are almost free from spontaneous leukemia, but carry the mammary tumor agent and the incidence of mammary tumors in breeding females is high. The F_1 females (118) were divided into five groups, one of which served as controls. An irradiated group was given whole-body x rays, 150 r at weekly intervals for four consecutive weeks. An estrogen-treated group was injected subcutaneously with an aqueous suspension of 20 μg of estradiol benzoate at weekly intervals for 20 weeks. A thymus- and spleen-grafted group received AKR tissues implanted subcutaneously. An x-irradiated thymus- and spleen-grafted group was also studied. The effects of these treatments on the incidence of leukemia were investigated (all leukemias developing in these experiments were lymphoid in nature). The untreated F_1 female hybrids developed leukemia only sporadically (two of 30 untreated mice or 6.7%, at 374 and 683 days), indicative of a low-leukemia line. The treated F_1 mice developed leukemia at significantly higher levels, according to the type of the treatment used. The F_1 hybrid mice exposed to whole-body irradiation or subjected to prolonged administration of estrogen developed leukemia more frequently, 66.7% and 26.3%, respectively. However, in the estrogen-treated group, 10 animals developed mammary tumors and 9 of these died without developing leukemia. It is probable that deaths due to mammary tumors may have rendered the incidence of leukemia in this group much lower than might otherwise be expected. Since the F_1 hybrids used presumably carry leukemia viruses, either in a masked or inactive form or at a low concentration, the results presented indicate that leukemogenic irritants, such as x rays and estrogens, may precipitate leukemogenesis in low-leukemia lines. Similar leukemogenic effects of x rays were observed in AKR X A/Jax F_1 mice in unpublished experiments. The incidence of leukemia in females transplanted with thymic and splenic tissues was significantly higher than in the control group, but pretreatment of the donor mice with x rays prior to transplantation did not enhance this effect. (BBB)

17659 EXPERIMENTAL STUDIES ON THE TREATMENT OF ACUTE RADIATION DISEASE BY PLASMA ADMINISTRATION AND BONE MARROW TRANSPLANTATION FROM CONVALESCENTS. Josef Panasewicz and Zofia Gloskowska (Zakladu Fizjopatologii, Warsaw). Polskie Arch. Med. Wewnetrznej, 32: 819-24(1962). (In Polish)

The protective effect of blood and hematopoietic tissue from sublethally irradiated rats was tested in supralethally

irradiated animals of the same strain. Plasma and bone marrow were taken from rats surviving acute radiation disease induced by 300 to 600-r whole-body doses of x rays, when hematologic values and body weight had normalized. The plasma or bone marrow from these convalescent rats was administered prophylactically or therapeutically to rats irradiated with an absolutely lethal dose of 1000 r. Treatment of the acute postirradiation syndrome by convalescent plasma of bone marrow, administered 40 days after irradiation, was no more effective than plasma and bone marrow of healthy animals. The survival time of 47 rats irradiated with a dose of 1000 r was less prolonged by pretreatment with convalescent plasma or bone marrow as compared with the effect of plasma or bone marrow from healthy animals. Convalescent plasma and bone marrow administered simultaneously were also less effective than preparation from healthy animals. (BBB)

17660 EFFECT OF RADIATION-PROTECTIVE PREPARATIONS ON THE DISTRIBUTION OF NEUTRAL RED AND THE HEMOGLOBIN CONTENTS OF ORGANS OF MICE AND RATS. P. G. Zherebchenko, G. M. Airapetyan, I. G. Krasnykh, and A. N. Shevchenko. Radiobiologiya, 4: 136-43(1964). (In Russian)

Compounds studied for their protective effect were injected into mice and rats 30 min before the animals were sacrificed. Determination of the hemoglobin in the organs showed a marked increase in hemoglobin in the spleen and some increase in the kidneys, blood, and liver when 5-methoxytryptamine or unitiol was given. 6-Methoxytryptamine caused some increase in the liver and blood, but 4- and 7-methoxytryptamine had no effect. When neutral red was also given 30 min before sacrifice of the animals, tryptamine or its derivatives, in which the fifth position of the indole ring was substituted, significantly decreased the accumulation of this dye in the spleen, skin, and bone marrow and increased it in the brain, muscle, lung, and kidney tissue. The action was similar to that of adrenalin. Nonprotective derivatives and homologs of tryptamine in which the side chain or the 4, 6, or 7 position of the indole ring was substituted had a comparatively small effect on the distribution of the dye. Cystamine, acetylcholine, and histamine caused less change in the concentration of the dye in the spleen than the amines of the indole series with high protective action, but increased the concentration in the lungs. Mercaptoamines caused significant changes in the dye accumulation only in the brain. In combination, cystamine with 5-methoxytryptamine or with unitiol increased the survival of irradiated mice, but 5-methoxytryptamine with unitiol had no effect. (TTT)

17661 INVESTIGATION OF CHEMICAL RADIOPROTECTORS AND RADIOSENSITIZERS. V. DIFFERENTIAL EFFECT OF A STIMULATOR OF CELLULAR GROWTH ON CHEMOTHERAPEUTIC AND RADIOTHERAPEUTIC LEUKOPENIA. S. Neukomm, M. Emch, and S. Rohn (Ecole de Medecine, Lausanne, Switzerland). Radiol. Clin., 32: 564-73(1963). (In French)

The administration of Solcoseryl (a cellular growth stimulator) to leukopenic rabbits reduced the post-chemotherapeutic leukopenia, casused by Endoxan, much more than the post-radiotherapeutic leukopenia after whole-body irradiation. There is a precise relation between dose and the effect of the product in the case of Endoxan-induced leukopenia in the rabbit. The anti-leukopenic effect is obtained when the Solcoseryl is administered immediately before Endoxan (for 5 days), whereas it appears clearly only when it is administered immediately after whole-body irradiation (for 5 to 11 days). Solcoseryl exercises a temporary stimulating effect on normal leukopoiesis (hyperleukocytosis of 20% on an average). (tr-auth)

17662 EFFECT OF DEXTRAN ON THE POSTIRRADIATION HEMORRHAGIC SYNDROME IN DOGS. Jaroslav Mazak (2nd Medical Clinic, Hradec Kralove, Czechoslovakia). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradec Kralove, Suppl., 4: 283-304(1961). (In Czech)

In nonirradiated dogs without artificial blood loss, dextran infusion increased capillary bleeding and led to a decrease in thrombocytes in a unit volume of blood. In nonirradiated dogs, thrombocytopenia following dextran was accompanied neither by impairment of prothrombin consumption nor of thromboplastin generation. After the infusion of dextran in irradiated dogs without artificial blood loss, a marked increase in capillary bleeding was noted in direct dependence with the dose of dextran used. Bleeding was significantly prolonged also. Postirradiation thrombocytopenia was always significantly aggravated by dextran, as were postirradiation changes in prothrombin consumption and thromboplastin generation tests. The possible use of dextran in the treatment of acute irradiation disease with post-irradiation hemorrhagic syndrome requires further investigation. (BBB)

17663 ROLE OF THE CENTRAL NERVOUS SYSTEM IN PROCESSES OF RESTITUTION AND COMPENSATION UNDER THE EFFECT OF RADIOPROTECTIVE AGENTS. S. J. Arbusov (Kirova Medical Academy, Leningrad). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, 6: 57-75(1963). (In Russian)

Evaluation of new radioprotective drugs, especially with neurophysiologic activity, is reported. Mercamine (beta-mercaptoamine) is not distributed uniformly in organs and tissues; quantitative differences were revealed in rates of its accumulation. In the central nervous system, 3 hr after the administration of ^{35}S-labeled mercamine, the amount of activity concentrated within the cerebral cortex was higher, than that of other organs. At 6 hr, activity of the mercamine-^{35}S decreased, while it rose in subcortical regions; 24 hr after its administration, almost all of the cerebral tissue activity was concentrated within the brain stem. Mercamine depresses excitation in the cerebral cortex. At segmental levels the central nervous system is very sensitive to the effect of this compound. Imidazole-2-carboxylic acid compounds, owing to their sedative effect, prevent any pathologic alterations of central nervous system reactivity (enhancement or depression). Administration of neuroplegic agents (aminasine and phenatin) reduces the extent of impairment and shortens the time of recovery of number of unconditioned responses (duration of postrotatory nystagmus, amount of unconditioned reflex salivation) in treated irradiated animals, as compared to untreated controls. This may be attributed to restitution of functions related to subcortical controlling mechanisms. (BBB)

17664 INCORPORATION OF P^{32} INTO THE DEOXYRIBONUCLEIC ACID OF SOME RADIOSENSITIVE ORGANS IN RATS TREATED WITH IODOACETIC ACID. M. Boccacci, M. Quintiliani, and L. Tentori (Istituto Superiore di Sanità, Rome). Sci. Rept. Ist. Super. Sanita, 1: 97-104(Jan. 1961).

It was confirmed that administration of iodoacetic acid (IAA) prior to whole-body irradiation results in a significant increase of the 30-day mortality of mice. Attempts were made to determine the mechanism whereby this effect might be brought about, by studying the response to radiations of some radiosensitive organs, such as spleen, thymus, and small intestine of rats treated with

IAA. Preliminary tests showed that IAA alone damages these organs. The lesions are more pronounced in the rat than in the mouse, and they appear only after the intraperitoneal administration of IAA, never after the intravenous administration of IAA. A dose of 40 mg/kg of IAA caused considerable inhibition of the incorporation of ^{32}P into the DNA of all three organs, both after intraperitoneal and intravenous administration. With a lower dose, 20 mg/kg, administered intraperitoneally, an inhibitory effect was still seen, but the differences were not significant. Treatment with IAA did not significantly influence the specific activity of either blood or thymus orthophosphate after ^{32}P injection. Effect of IAA on the incorporation of ^{32}P into the DNA of the regenerating liver was also studied; a time curve for the incorporation of ^{32}p into the DNA of regenerating liver at various intervals following partial hepatectomy shows a maximum in the incorporation rate at 24 hr. Intraperitoneally administered IAA (40 mg/kg) caused a marked inhibition of the incorporation of ^{32}P, while its intravenous administration resulted in no inhibition. These results demonstrate that IAA has a distinct inhibitory effect on the incorporation of ^{32}P into the DNA of some radiosensitive organs. Among the various possible hypotheses concerning its mechanism of action, it is suggested that IAA interferes with glycolysis by inhibiting the glyceraldehyde phosphate dehydrogenase, a key enzyme in the regulation of metabolic processes. The inhibition of this enzyme might lead to a decrease in the sources of energy which the cell needs to function normally, and specifically the synthesis of precursors needed for the duplication of the DNA. Another hypothesis is that substances capable of reacting with thiol groups interfere with the formation of the mitotic apparatus. The effect of IAA manifests itself predominantly in the preprophase period, inhibiting the beginning of mitosis; IAA is less active after the beginning of the mitotic process. It is concluded that IAA acts during preprophase stage by interfering with the DNA synthesis. (BBB)

17665 ACTINOMYCIN D: SUPPRESSION OF RECOVERY IN X-IRRADIATED MAMMALIAN CELLS. M. M. Elkind (National Cancer Inst., Bethesda, Md.). G. F. Whitmore, and T. Alescio. Science, 143: 1454-7(Mar. 27, 1964).

The lethal effect of two x-ray doses can be considerably enhanced if cultured cells are exposed to actinomycin D between doses. Net survival can be modified by temperature as well as actinomycin treatment. These effects are related to repair of sublethal damage and to cell kinetics between doses. (auth)

17666 PEAT FIGHTS RADIATION SICKNESS. Tekhn. Molodezhi, No. 12, 29(1963).

Research has shown that some organic compounds contained in peat offer protection against x rays. Substances derived from decomposed peat were given to mice and rabbits one-half hour prior to the administration of a lethal dose of radiation. The animals withstood the radiation without any ill effect. (OTS)

17667 WHAT MAY ONE EXPECT FROM BONE MARROW TRANSFUSIONS IN MAN? G. Mathe (Centre Medicochirurgical Foch., Suresne, France). Therap. Semaine Hop., 37: 810-12(Nov. 1961). (In French)

Marrow transfusions in 11 patients are reported, and the technical and immunologic problems involved in bone marrow grafting are discussed. Two cases are reported of successful grafting in humans, one, in a patient with generalized marrow aplasia, following treatment with triethylenethiophosphoramide and the other in a Hodgkins disease patient, with aplasia, treated by chloraminophenylbutyric acid. Irradiated animals receiving homologous grafts frequently develop a secondary syndrome from the 20th to the 100th day, which usually proves fatal. Symptoms consist of digestive disorders (diarrhea); various dermatitises; general symptoms such as infections, loss of weight, cachexia; hematologic disturbances (hemolytic anemia, lymphopenia, lymphoid aplasia, and necroses). Practical experience of homologous grafts in the human, following irradiation, is reduced to two groups of subjects: a group of five Yugoslavian scientists accidentally irradiated by large doses of neutrons and γ rays and six leukemic infants who received whole-body irradiation by ^{60}Co γ ray doses of 850 to 900 rad during remission periods, followed by homologous transfusions of marrow. Experience showed that marrow grafting can be an effective therapeutic procedure against whole-body irradiation-induced aplasia, but the indication and precise moment for its use are not easily determined. It is suggested that this treatment should be reserved for cases exposed to doses above 500 rem and showing evidence of severe marrow aplasia, and that patients should be maintained under aseptic conditions with antibiotics, γ-globulins, platelets, and eventually blood transfusions. (BBB)

17668 HYPOTHESES CONCERNING THE EFFECTS OF CHEMICAL RADIATION PROTECTION AGENTS. J. E. Pany (Universität, Vienna). Wien. Med. Wochschr., 112: 795-801(Oct. 13, 1962). (In German)

The discovery that radiation of aqueous solutions of inorganic and organic compounds produces ionization and radical formation has aroused speculation as to the mechanism of action by which radiation protection agents may exert their effects. Protective substances include S-containing compounds, reducing agents, H transport compounds, hormones, amines, complexing agents, and substances that induce hypothermia. There is no general theory that explains the favorable actions of these substances fully. According to the hypothesis of disulfide formation, the S-H groups of these compounds form mixed disulfides with the SH groups and S-S bridges of proteins that prevent their reacting with the free radicals produced by radiation. The S-S linkages are considered to be the most stable. According to this hypothesis, it is these groups that are most damaged by radiation. The value of SH compounds is limited, and seems to be related to their effectiveness as energy-transfer agents. Reaction with free radicals formed by radiation to destroy or stabilize them is another basis suggested for the action of protective compounds to reduce or prevent effects of radiation. The presence of H increases the reactivity of these substances. The anoxia hypothesis is based on the fact that the range of partial pressure over which H is effective is only ~25 mm Hg, and for this reason, the effects of thiols, for instance, may be due to their effect to reduce the partial pressure of H. Experimental findings indicate that changes in H concentrations in cells may have some effect in mammals, but it cannot be regarded as the decisive factor in radiation protection by thiols. A pharmacological effect to reduce the O tension in tissues (hypoxia) is the suggested mechanism for the protective effect of amines. However, the varied pharmacological effects of these compounds are too widespread to permit their radiation protective effects to be ascribed to any one simple basis. Also, there are insufficient studies available to permit a final conclusion to be reached. There is probably no single explanation for the effects of radiation protection chemicals. (BBB)

17669 HUMAN GAMMA GLOBULIN AND CALF SERUM TESTED AS RADIATION PROTECTION AGENTS IN GUINEA PIGS. E. Gabler (Prosektur des Wilhelminenspitals der Stadt Wien, Vienna). Wien. Z. Inn. Med. Grenzg., 43: 105-7(Mar. 1962). (In German)

During studies of the passive transfer of protein allergy after lethal radiation doses, using bone marrow transfusions, two substances were found to give protection from radiation after a lethal dose was given. One of these is a calf serum, and the other is human γ-globulin. Thirty min after 550-r whole-body x irradiation, 145 guinea pigs were given 1 ml of calf serum or 1 ml of γ-globulin. After each treatment ~50% of the animals survived. Radiation death was demonstrated postmortem. If the γ-globulin was given ~2 weeks before the exposure to radiation, ~70% of the animals survived. No improvement in the survival rate was found if the γ-globulin was given daily for two days after the radiation. When human albumin was administered with these substances, there was no increase in the number of animals that survived the radiation exposure. The results suggest that γ-globulin may protect at least half of the animals from radiation death. The animals from the initial experimental series survived for more than three months. Additional studies of the effects of these two substances are being carried out in rats, mice, rabbits, and other animals in order to establish the mechanism of effect. (BBB)

17670 STUDIES ON THE THIAZOLIDINECARBOXYLIC ACID DERIVATIVES AS THE PROTECTIVE AND RESTORATIVE AGENTS AGAINST RADIATION INJURY. Hiroyasu Watanabe, Akio Ide, et al. (Tanabe Seiyaku Co., Ltd., Japan). Yakugaku Zasshi, 83: 1118-24(1963). (In Japanese)

Thiazolidinecarboxylic acid derivatives were synthesized for use as agents against radiation injury. Their protective and restorative effects were examined by the mortality of mice exposed to a lethal dose of x rays. Of 16 derivatives, 2 were found to be protective and restorative, 2 protective, and 1 restorative. Three had no restorative effect on the hematologic injury of rats caused by x radiation. These derivatives protected from death the mice injected with an otherwise lethal dose of sodium arsenite and diminished the necrosis of liver caused by carbon tetrachloride. (from NSA of Japan)

17671 PROTECTION OF HAMSTERS BY DIETHYLSTILBESTROL FROM THE ACTION OF X RAYS. I. A. Nechaev. p.198-203 of "Deistvie Ioniziruyushchikh Izluchenii na Organizm." Moscow, Publishing House of the Academy of Sciences, 1962.

Male golden hamsters (Cricetus auratus), 2.5 months old, were x-irradiated with 400 or 600 r in a single dose. They had been previously injected with 1.2 mg of diethylstilbestrol. This drug showed some protective effect, though considerably less than beta-mercaptoethylamine for hamsters or diethylstilbestrol for mice as reported in the literature. With the hamsters and diethylstilbestrol the mortality rate in the 400-r group was almost eliminated and that in the 600-r group was lowered during the 30-day postirradiation observation period. Actual death rate values for the hamster-diethylstilbestrol experiments were: in the 400-r group, control 40% and protected 5%; in the 600-r group, control 80% and protected 65%. Comparative literature values for hamster and beta-mercaptoethylamine protection against a 600-r dose are: controls 77% and protected 7%. In the hamster-diethylstilbestrol experiments the weights of the protected and nonprotected survivors of both irradiation doses were parallel with time, but at the 270th day none had reached the values for the nonirradiated controls. Hamsters protected by diethylstilbestrol did not live longer than surviving controls. 14 references. (TTT)

Radiation Hazards and Protection

17672 (HW-tr-67) CONTAMINATION OF MILK AFTER AN ACCIDENTAL ATMOSPHERIC FALLOUT OF IODINE-131. R. J. Kirchmann and R. R. Boulenger. Translated by E. R. Appleby (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.), from paper presented at "Radioactive Contamination in Gaseous Media," Saclay Symposium, Nov. 12–16, 1963. 17p.

Two series of experiments were performed in 1962 and 1963 to determine if the figures for ^{131}I concentration in milk from the Windscale accident were also valid for the region adjacent to the C. E. N. installations. Pastures were contaminated with a spray of ^{131}I solution, and the effects of the variables (height and nature of pasture, season, and meteorological conditions) were studied. The contamination of grass was also studied. The results gave values of 0.0224 μC/l for a deposition of 0.4 $\mu C/m^2$ and 0.024 μC/l for a deposition of 0.62 $\mu C/m^2$, as compared to the Windscale value of 0.065 μC/l for a deposition of 0.4 $\mu C/m^2$. Possible reasons for the difference are discussed. (D.L.C.)

17673 ON THE RECENT RADIATION ACCIDENTS. THE ELECTRON BEAM INJURIES. Tadashi Fukuda and Yasuto Onoyama (Kyoto Univ.). Genshiryoku Kogyo, 9: No. 9, 41-4(Sept. 1963). (In Japanese)

Radiation injuries caused by electron accelerators are discussed. Two characteristics are: due to the high power source, a large dose is received in a short time; and an electron beam up to 1 Mev is absorbed mainly in the surface layer of the skin, and the whole body effect is small. Two recent electron-accelerator incidents are reported, one by a Van de Graaff at 1.5 Mev, 250 μ A, and another by a Cockcroft-Walton accelerator of 2 Mev, 3mA. The absorbed dose was about 10^4 rads in each case. The symptoms over 2 years are described. In general, electron beam burns have 2 stages, the first acute stage of 3 to 9 weeks after exposure, and the following chronic one. Even in the chronic stage, a slight irritation may form an ulcer, so prolonged care is necessary. It is most important to protect the affected part from irritation, keep it quiet, and prevent infection. (From NSA of Japan)

17674 MEASUREMENT OF LARGE AND CATASTROPHE-LEVEL γ-RADIATION BY MEANS OF FILMS. Iván Bojtor, István Kiss, and Gyula Koczkás (National Inst. for X-Ray Studies and Radiation Physics and FORTE Photochemical Industrial Research Lab., Budapest). Magy. Fiz. Folyoirat, 11: 1-5(1963). (In Hungarian)

An exact determination of dose in the very large radiation dose range is very helpful for ensuring the proper treatment of exposed persons. Tests were therefore carried out to extend the range and to increase the precision of previous photographic dosimetric methods in the lethal dose range. Positive cine film was used for the study in the 20- to 600-r range, in which the energy dependence of the film's sensitivity could be compensated. A ^{137}Cs source was used for the irradiation and the dose determined before exposure by means of a Victoreen meter. The densitometric data obtained with 10 different exposed

films was compared. The results indicated that the film type examined may be used for making reliable and practically energy-independent measurements of the γ dose up to the lethal dose range. (TTT)

17675 RADIATION HAZARDS. A REVIEW. J. A. Bloomfield. Radiographer, 9: 10-13(Sept. 1962).

17676 A CONTRIBUTION TO THE KNOWLEDGE OF THE SCREENING METHOD OF URINE ANALYSIS FOR WORKERS USING RADIOACTIVE MATERIALS. Hiroko Kasakawa (Tokyo Univ.). Radioisotopes (Tokyo), 12: 293-9(Aug. 1963). (In Japanese)

Akaishi's method was evaluated experimentally to determine its applicability to routine health supervision of workers using radioactive materials. The following results were obtained: different nuclides in urine samples are recovered in different amounts; recovery of a particular nuclide varies when urine samples are taken from different subjects; the amount of NaOH to be added to the urine for the first procedure of Akaishi's method must be adjusted to get the maximum rate of recovery of the nuclide; and the recovery of the nuclide decreases daily. It is concluded that individual differences in urine samples based mainly on biological background should be clarified before Akaishi's method is used routinely. (from NSA of Japan)

Radiotherapy and Radiodiagnosis

Refer also to abstract 18104.

17677 (CONF-453-2) A THEORY OF RADIOISOTOPE SCANNING SYSTEMS. Robert N. Beck (Argonne Cancer Research Hospital, Chicago). [1964]. Contract [AT(11-1)-69]. 18p. (SM-51-52)

From IAEA Symposium on Medical Radioisotope Scanning, Athens, Apr. 1964.

Theory for collimated scintillation detector systems for spotting lesions in body organs is presented. Relations are derived for the efficiency and response of the system; the transfer function approach to the response is outlined. A system figure of merit is also defined, and a method for optimizing the scanning, in terms of information content, when the lesion size is completely unknown is described. (D.C.W.)

17678 TOTAL BODY IRRADIATION. Patricia Hope McIntyre (National Naval Medical Center, Bethesda, Md.). Am. J. Nursing, 61: 62-4(Sept. 1961).

Techniques of whole-body irradiation and bone marrow replacement therapy in patients with malignant diseases are described, with emphasis on care of the irradiated patient. (BBB)

17679 RADIATION IN THE DIAGNOSIS AND TREATMENT OF DISEASE. Norman Simon (Mt. Sinai Hospital, New York). Am. J. Publ. Health, Suppl., 54: 57-62(Jan. 1964).

Increasing use of radiation for diagnostic and therapeutic procedures and the attendant hazards are considered. It is noted that even though radioisotopes are being used more and more for diagnostic purposes, they are presenting less and less hazard to the patient and user. Development of sensitive detecting and measuring instruments makes it possible to do diagnostic tests with isotopes at very low doses of radiation. Studies are reviewed that have shown a relation between leukemia and radiation. These studies indicate that leukemia is induced by irradiation at high doses, but not necessarily at low doses. Also, there is conflicting evidence, sometimes even at high doses. Methods for lowering the significant genetic dose are presented. The role of inspection and registration of radiation equipment by state and local health as factors in reducing dose is discussed. (BBB)

17680 FUNCTIONING HOMOGRAFTS OF THE LUNG IN DOGS. David A. Blumenstock, John A. Collins, Herbert B. Hechtman, E. Donnall Thomas, and Joseph W. Ferrebee (Mary Imogene Bassett Hospital, Cooperstown, N. Y.). Ann. N. Y. Acad. Sci., 99: 882-90(Oct. 24, 1962).

Irradiation and chemotherapy were used to alter the immune response to homografts of the lung and to allow prolonged graft survival. Eleven dogs were exposed to whole-body irradiation delivered at a rate of 4.4 r/min from twin Co^{60} sources to midpoint air doses ranging from 1080 to 1770 r. Homologous bone marrow injections (up to 31 billion cells) were given in some cases, along with methotrexate. Five dogs died during the first week, an interval too short to evaluate marrow engraftment. Three animals lived for more than 6 weeks; their lung fields were clear on x-ray examination. Two animals exhibited leukopenia during the 5th to 6th week of treatment with methotrexate. When the drug was discontinued the leukocyte counts rose to levels of 20,000 to 35,000/mm^3 and remained elevated until death. There was no evidence of homograft rejection in sections of the transplanted lung. A single animal survived 6 months (death was associated with malnutrition). At autopsy the lung contained many bacteria and leukocytes but showed no perivascular collection of round cells, and alveolar walls appeared normal. Five additional dogs were exposed to donor blood along with radiation, chemotherapy, or a combination of the two. Several survived for nearly a year. These results show that irradiation and chemotherapy, procedures known to affect the immunological response, can be used to prolong the survival and function of homografts of the lung. The use of high doses of whole-body irradiation combined with homologous grafts of marrow and lung produced an excessive mortality in the recipient although the histological structure of the transplant was preserved. Treatment with methotrexate alone was insufficient to block completely the rejection response. In most instances death was associated with vomiting, diarrhea, and dehydration, symptoms of drug toxicity. The use of methotrexate or irradiation, or both, to suppress immune reactions during a pretransplant exposure of the recipient to donor antigen in the form of blood provided the most satisfactory result with the systems thus far tested. (BBB)

17681 ERYTHROKINETICS IN NUCLEAR-MEDICAL ROUTINE DIAGNOSTIC. THEORETICAL AND METHODICAL PROGRESSES IN THE HEMATOLOGICAL EXAMINATION WITH ^{51}Cr AND ^{59}Fe. H. Kuni, E. H. Graul, and H. Hundeshagen (Philipps-Universität, Marburg an der Lahn, Ger.). Atompraxis, 10: 126-9(Mar. 1964). (In German)

A report is given of the simplification of the erythrokinetic examination with ^{51}Cr and ^{59}Fe to a routine method by giving most possible information. By this the following new methods were developed: a rapid method for the determination of blood volume with ^{51}Cr-erythrocytes based on ion exchange; ^{59}Fe determination in a 24-hr sample of urine following an intravenous injection of desferrioxamine; and an equation, describing the curve of utilization that allows measurement of conventional disappearance rate and determination of the iron pool of erythrons by a routine

method. With the help of the ^{51}Cr-Ery-Vita the interpretation of older data investigations in the new points of view is possible. Pathology of iron metabolism is taken into account by special equations. (auth)

17682 MATHEMATICAL ANALYSIS OF THE RADIORENOGRAM CURVE BY MEANS OF THE EXPONENTIAL MODEL. F. Vitek (Charles Univ., Prague). Atompraxis, 10: 130-4(Mar. 1964).

A mathematical model of the kinetics of o-iodohippuric ^{131}I acid for the evaluation of radiorenograms was elaborated. The model makes it possible to determine uptake-rate coefficients and excretion-rate coefficients of the separate kidneys, the total uptake and amount of excreted activity by the separate kidneys by means of the graphical and numerical analyses of renogram curves and the curve of the activity loss in the blood. (auth)

17683 THE INFLUENCE OF RADIOISOTOPES ON THE EEG. V. Kvicala and J. Stein (Charles Univ., Prague). Cesk. Neurol., 26: 27-32(Jan. 1963). (In Czech)

Electroencephalograms (EEG) were made of 40 patients of whom 29 had intracranial tumors, before and within 24 to 48 hr after use of a diagnostic dose of a radioiodine. In the majority of cases the EEG recordings showed no significant change after the injection of ^{131}I. Only in five cases were recordings more pathologic, while in two cases (one pituitary adenoma and one metastatic tumor of the posterior fossa) there was marked improvement in the character of the EEG tracing. It is suggested that the EEG changes were due to the course of the disease process, and that a diagnostic dose of ^{131}I does not affect the EEG. The dose of ^{131}I-labeled serum albumin used was ~3 μC/kg body weight. (BBB)

17684 ELECTRONIC WEAPON AGAINST CANCER. N. A. Austin (Varian Associates, Palo Alto, Calif.). Electronics, 37: 88-92(Apr. 6, 1964).

The use of clinical linear accelerators to produce high-energy x radiation or direct electron beams to kill cells in deep-seated tumors is discussed. The design, auxiliary systems, operation, and dosimetry of clinical accelerators are reviewed. (C.H.)

17685 HERPES ZOSTER AFTER IRRADIATION. Kazue Kimura, Aiji Anazawa, and Kinsuke Takakuda (Fukushima Medical Coll., Japan). Fukushima Igaku Zasshi, 12: 329-33(Oct. 1962). (In Japanese)

Clinical and pathologic findings are described in four patients with malignant tumors in whom herpes zoster eruptions occurred after x irradiation of mediastinal or retroperitoneal regions. The four cases were among 67 patients whose spinal cords were irradiated for various neoplasms from 1953 to 1959. Autopsies were performed in three cases. The skin areas affected by herpes zoster were the irradiated ones in all cases; in one case nonirradiated skin was also attacked, but it was in the area innervated by the irradiated spinal tracts. (BBB)

17686 THE EFFECT OF BREATHING OXYGEN, INJECTION OF SEROTONIN, AND CHANGES OF SYSTEMIC BLOOD PRESSURE UPON THE OXYGEN TENSION IN TUMORS. D. B. Cater (Cambridge Univ., Eng.). Giorn. Ital. Chemioterap., 6-9: 240(July-Sept. 1962).

Before and after irradiation the oxygen tension of normal and tumor tissues was followed by a polarographic method in volunteers and cancer patients. The resting level of oxygen tension and the response to breathing oxygen at atmospheric pressure were measured before and after radiotherapy. The ratio (tissue Po_2 when breathing oxygen for 10 min/tissue Po_2 when breathing air) was a constant of mean value 2.1 to 2.3 in all tissues studied except bone marrow. After completion of radiotherapy this ratio was significantly increased to 2.9 in tumor tissue but not in the surrounding irradiated normal tissue. The effect on tumor oxygen tension of the radiosensitizer tetrasodium 2-methyl-1,4-naphthohydroquinone diphosphate (Synkavite) was negligible, but heating of tumor by short-wave diathermy markedly reduced both resting levels of oxygen tension and the response to breathing oxygen. Data from anemic patients showed the importance of correcting this condition before radiotherapy, or of giving such patients oxygen to breathe during radiotherapy if high oxygen tensions are to be obtained in the tumors. A preliminary study was made on the effects of vasodilator and vasoconstrictor drugs upon tumor oxygen tension by recording tumor oxygen tension and blood pressure while marked changes of systemic blood pressure were induced by inhalation of high concentrations of CO_2 or amyl nitrate, or injection of serotonin. In most cases, tumor oxygen tension followed closely changes in systemic blood pressure, presumably due to changes in tumor blood flow, suggesting that there is very little local vasomotor control of tumor blood flow. High concentrations of CO_2 in the inspired air gave a marked increase of tumor oxygen tension. In contrast, serotonin (a known radioprotector) produced a much greater fall of oxygen tension in tumor than in bone marrow or muscle and this fall could not be accounted for by the small fall of blood pressure. (BBB)

17687 PROGRESS REPORT ON THE USE OF RADIOSENSITIZERS IN THE TREATMENT OF MALIGNANT TUMOURS AT THE DEPARTMENT OF RADIOTHERAPEUTICS, UNIVERSITY OF CAMBRIDGE. D. B. Cater (Cambridge Univ., Eng.). Giorn. Ital. Chemioterapia, 6-9: 235-9(July-Sept. 1962).

Synkavite (tetrasodium 2-methyl-1,4-naphthohydroquinone diphosphate) not only inhibits mitosis in tissues, but when used in combination with x rays its inhibitory effect is more than additive. Besides being a radiosensitizer, it is selectively concentrated by tumor tissue. Malignant cells in tissue culture are rapidly labeled when exposed to ^{3}H-Synkavite; after 30-min exposure, HeLa cells showed more than 100 times the concentration of Synkavite compared with normal human amnion cells. Full labeling was observed in every cell of all the cell types used within 2 to 5 min of treatment both in vitro and in vivo. This suggests that the compound enters the cell in unchanged form by a process of active transport because of its phosphate groups. Tritium labeling of cells treated with active ^{3}H-Synkavite persists in tissue culture through more than 29 generations of cells. In clinical trials, patients with inoperable carcinoma of the lung survived longer when given intravenous Synkavite and x rays than when given intramuscular Synkavite and x rays or x rays alone, 9.8 months compared with 5.5 or 4.4 months respectively. Attempts to use Synkavite to carry radioisotopes into tumor tissue have also been made. Synthesis of a stable T compound was obtained by reductive dehalogenation of 6-iodo-2-methyl-1,4 naphthohydroquinone diphosphate. Tritium-Synkavite half life was determined by measuring specific activity of serial biopsies of an adenocarcinoma. The specific activity decreased exponentially with a half life of 13 days. Therefore, dosage could be calculated on the basis that 1 mc of T/g of tissue delivers 308 rep in 24 hr of 287 rad in 24 hr, assuming a mean energy of β particles of 5.6 kev. The RBE of T β particles is 1.7 compared to ^{60}Co γ rays, but it is possible that the true RBE is somewhat lower,

perhaps 1.4. In some of the 46 carcinoma patients treated with ^{3}H-Synkavite, relief was a striking feature, and in some cases there was objective evidence of tumor regression and an improved status of the patient. Of 36 cases assessed, 9 were improved, 4 made worse, and the remainder appeared unchanged. Some successful results in tumor-bearing dogs and cats are also reported. (BBB)

17688 TESTS ON TELETHERAPY SOURCES SEALED WITH LEAD O-RINGS. K. W. Haff. Isotopes Radiation Technol., 1: No. 2, 196-9(Winter 1963-64).

Eighteen lead O-ring ^{60}Co teletherapy sources from 5 to 8 years old were tested to determine the effects of age on them and precautions that would be required in their reuse. The sources were found to be able to withstand considerable physical shock. However, since they all leaked, their lead O-ring gaskets were in poor condition, and transferable contamination was high, it was recommended that sources of this type be reencapsulated in an all-welded stainless steel can before being reused. (M.C.G.)

17689 FACTORS INFLUENCING RADIOCURABILITY OF CARCINOMA OF THE CERVIX. R. G. Bourne (Queensland Radium Inst., Brisbane). J. Coll. Radiologists Australasia, 7: 126-30(June 1963).

Radiation dosage, host response, and tumor response are discussed. The dose of radiation used should be adequate for cancericidal effect and in most clinics careful application of Ra is used to achieve this aim. An adequate dose to the cervix is defined as 8000 r. Radioresistance is a relatively infrequent cause of radiation therapy failure and therefore has been overemphasized. The following factors reduce the radiocurability of carcinoma of the cervix: pregnancy; prognosis is much worse in the last trimester and after delivery; anemia; if the hemoglobin level is less than 11 g%, the survival rate is reduced; infection worsened prognosis; stenosis of vaginal vault due to tumor infiltration reduces survival rate; and abnormal urological findings decrease survival rate. The stage of the tumor is the most important single factor influencing survival of patients with carcinoma of the cervix. The extent of local spread and lymphatic involvement by malignancy is greater in the later stages, so that it is difficult to apply a cancericidal dose to the large volume of involved tissue without exceeding the tolerance of normal tissues. The use of various tests to determine tumor radiosensitivity and their validity are discussed. As yet, their usefulness is doubtful. (BBB)

17690 EFFECT OF IRRADIATION ON THE GROWTH OF INTRACEREBRAL GLIOMAS IN MICE. Fredric L. Edelman, Fernando Aleu, Labe C. Scheinberg, John C. Evans, and Leo M. Davidoff (Yeshiva Univ., New York). J. Neuropathol. Exptl. Neurol., 23: 1-17(Jan. 1964).

The effects of x rays on a transplantable intracerebral glioma in inbred C57BL/6 mice were studied. For irradiation the mouse was immobilized in a glass tube and all of its body except the head shielded with a sheet of lead. X-ray therapy was then administered (physical factors used were 280 kv, with a half-value layer of 2 mm Cu or 0.17 mm Cu and a target skin distance of 50 cm) at a dose rate of 140 r/min. A total tumor dose of 1100 or 1840 r administered in five divided doses between days 10 and 24 after tumor implantation was curative for a small number of mice, and retarded the rate at which the other animals died. With the same schedule of irradiation, a total dose ranging from 2200 to 3000 r was essentially curative. A total dose of 3500 r caused death from irradiation effects. Data on the effect of fractionation on the result of therapy are also presented. A total dose which is curative if administered in five divided doses from days 10 to 26 after implantation caused death from radiation if administered in three divided doses between days 10 and 15 after implantation. About day 25 to 30 after the first x-ray treatment, the mice began to show periorbital and scalp epilation, but mice which received a curative total tumor dose of 2200 r appeared healthy throughout. Histologic examination of the brains of mice killed serially during a curative therapy revealed that x rays altered development of the implanted tumor by decreasing its cellular activity, which was followed by a reduction in size of the tumor. Thus, two days after the first dose, in animals being given a curative course in five divided doses, there was widespread early degeneration of neoplastic cells (hyperchromatism, pyknosis, and karyorrhexis). Some cells assumed giant proportions, and their nuclei become large and hyperchromatic, with an irregular outline and a grotesque appearance. Multinucleated giant tumor cells were seen occasionally. Untoward effects of irradiation upon the neuron population were not observed in cured mice. In mice dying from an overdose of x rays the brains were normal; however, there was radiation reaction with superficial ulceration of the oropharyngeal epithelium and focal interstitial hemorrhages in the lungs. Thus, these mice died from the effects of radiation on contiguous organs, which could not be adequately shielded. (BBB)

17691 PERCUTANEOUS INTERRUPTION OF SPINAL-PAIN BY MEANS OF A STRONTIUM NEEDLE. S. Mullan, P. V. Harper, J. Hekmatpanah, H. Torres, and G. Dobbin (Univ. of Chicago). J. Neurosurg., 20: 931-9(Nov. 1963).

Use of a 19-gauge needle, containing 54 mO of ^{90}Sr–^{90}Y in its tip, to produce spinal cord lesions and relief of intractable pain in metastatic cancer patients is described. It was possible to plan a field of β irradiation to any desired depth in the anterolateral cord. The needle, inserted at 45° to the sagittal plane, lies against the anterior dura mater 3 mm from the midline. Increasing or decreasing penetrations may be provided by moving the point of the needle in relation to the midline or by altering the period of radiation. A needle entering at 45° with its tip 3 mm fr from the midline will deliver 16,000 rad at 3 mm from its axis, 6000 rad at 4 mm, and 2000 rad at 5 mm if kept in place for 15 minutes. Death of tissue is complete in these zones on the 3rd, 12th, and 90th days respectively. The cross-sectional areas involved are ~5.25, 3.6, and 5.25 mm^2. Percutaneous anterolateral cordotomy was performed on 42 patients, using the needle introduced between the laminae of C1 and C2. Of these 42 patients, 34 had satisfactory relief from pain following the procedure. One patient with herpes and one with tabes experienced no relief, but the dose used may have been inadequate. Weakness of mild degree developed in five instances and was severe in one. This weakness in all cases was related to overdosage. There was no evidence of damage to the cord by puncture with the needle or intraspinal hemorrhage. There was no mortality and no period of convalescence. Technical simplicity and safety allow the surgeon to offer relief from pain to a much greater number of patients than was possible with standard surgical cordotomy. (BBB)

17692 RADIOISOTOPE LOCALIZATION FOR RENAL BIOPSY. Nancy Telfer, Albert E. Ackroyd, and Stanley L. Stuck (Woman's Medical Coll., Philadelphia). Lancet, 1: 132-3(Jan. 18, 1964).

A new technique is described for determining the position of the kidneys prior to needle biopsy. It depends on the ability of the kidney to concentrate ^{203}Hg-labeled chlormerodin. A 10-μC dose is used, which is one-tenth the

dose required for scanning. This is injected intravenously about 45 min before the biopsy is to be done. The patient is placed in position for the biopsy, and the two areas of greatest activity are located with a portable scintillation detector, which consisted of a 1-in. Tl-activated NaI crystal shielded by ½ in. Pb. The γ rays emitted from ^{203}Hg are absorbed by the crystal, and the resulting photoelectric impulses are amplified by a photomultiplier tube and fed into a battery-operated counting ratemeter. The entire detecting system is portable and localization requires only 10 to 15 min and at the same time indicates renal function on both sides. The position of the kidneys is verified with an exploring needle, and the biopsy is done. Results with the procedure in 11 patients are reported. The advantages of this new method are listed. (BBB)

17693 RADIOACTIVE ISOTOPES IN MEDICINE. Robert J. Dickson (London Clinic). London Clin. Med. J., 3: 39-46(July 1962).

Criteria for the selection and the advantages of various radioisotopes in diagnostic and therapeutic techniques are discussed. Evaluation of available isotopes, especially for detecting tumors in different organs, is made. The type of emission, tumor/tissue uptake ratios, required detection instrumentation, dosages, and hazards associated with the following isotopes are outlined: ^{32}P, ^{42}K, ^{131}I, ^{74}As, ^{64}Cu, ^{198}Au, ^{47}Ca, ^{85}Sr, ^{65}Zn, ^{75}Se, and ^{203}Hg. The most successful of these isotopic procedures for tumor localization is the use of radioiodine in thyroid disturbances, but most other procedures are relatively unselective. Until more satisfactory localization is achieved, the usefulness of these procedures is limited. However, the amount of radioactive material administered in each investigation is minute, radiation dosage to patient and operator negligible, no operative procedure is required, and no after-effects occur. (BBB)

17694 INVESTIGATION AND TREATMENT OF THYROID DISORDERS. Robert J. Dickson (London Clinic). London Clinic Med. J., 3: 11-26(Jan. 1963).

The use of iodine isotopes, dosages, dosimetry, instrumentation, and hazards are extensively examined. Consideration of the risks indicates that no case of induced carcinoma of the thyroid following ^{131}I treatment in humans was reported and that the number of cases of leukemia arising in patients so treated is no more than would be expected in the general population. Sporadic cases of hypothyroidism occurring after apparently successful control of overactivity with ^{131}I are reported, and add to the uncertainty of late results of this treatment. Other factors contraindicating use of ^{131}I, such as pregnancy, are considered. Dosimetry considerations showing three different methods of using ^{131}I in the therapy of hyperthyroidism are discussed. (BBB)

17695 ISOTOPES IN HEMATOLOGICAL AND RELATED STUDIES. Robert J. Dickson (London Clinic). London Clin. Med. J., 4: 37-46(July 1963).

Advantages of various isotopes for diagnostic clinical studies are considered (^{32}P, ^{51}Cr, ^{55}Fe, ^{59}Fe, ^{56}Co, ^{57}Co, ^{58}Co, ^{60}Co, ^{22}Na, ^{28}Mg, ^{42}K, ^{47}Ca, ^{85}Kr, ^{14}C, ^{35}S, ^{131}I, ^{133}Xe, and ^{203}Hg). (BBB)

17696 RADIATION TREATMENT OF THE EYE AT HIGH DOSES WITH EFFECTIVE PROTECTION OF THE ANTERIOR THIRD OF THE EYE. Karoly Arato and Sandor Eross (János Kórház Rõentgenlaboratoriuma és Szemeszeti Osztálya, Budapest). Magy. Radiol., 14: 354-7(1962). (In Hungarian)

A method is described for reducing damage to the eye in which the x-ray beam is sharply limited; the anterior part of the eye is protected by Pb, the x-ray tube is precisely focused, and movement of the eye during treatment is limited. A Reese-Kovacs tube was modified with a safety device for aiming the beam. It consists of a Cu tube conically lined with Pb, with exchangeable nasal, temporal, and frontal extensions. To this a bracket was attached for holding an aiming pin, and an adjustable small mirror for sighting to hold the eye in a fixed position. Tube focus was 40 cm, and the openings of the conical Pb liner were 6 mm at the focus end and 22 mm at the open end. Thus the irradiated circular zone has a diameter of 22 mm; the nasal and temporal extensions shade an 8-mm segment of this circle, protecting the most radiosensitive parts of the eye. When x-ray treatment was conducted at 180 kv, 10 ma, 0.5 mm Cu filtration, and 31 r/min, it was found that 57% of the surface radiation reached the eye from the temporal extension, and 77% of the radiation reached the area from the nasal extension. The higher latter value is explained by the thicker bone on the temporal side of the skull as compared to the thin bone in the nose. Thus the nasal approach can be used more effectively to reduce eye exposure. Treatment of an eye tumor cannot be carried out effectively when the eye is closed, as it is usually turned upward and the tumor may only be partially exposed to x rays. Any movement of the eye to the side should also be eliminated for the same reason; therefore, a mirror is used to fix the eye at its least vulnerable position. The treatment of a patient with bilateral orbital adenocarcinoma is described who received 300-r fractions every two days for a period of two months totaling 5400 r in one eye and 4800 r in the other. The tumor regressed in both eyes and vision was preserved. Present data indicate that the irradiation of such a small area as provided by this device is well tolerated in all age groups. In infancy and childhood a fractional dose of 250 to 300 r every two days to a total of 8000 to 10,000 r produces a slight reddening of the skin, which, however, is without permanent effect. Adult skin can tolerate doses up to 600 r every two days up to a total of 12,000 without ill effects. (BBB)

17697 RADIOISOTOPE SCANNING IN CLINICAL DIAGNOSIS. Charles P. Winkler and Felix J. Pircher (Duke Univ., Durham, N. C.). N. Carolina Med. J., 24: 377-80(Sept. 1963).

The use of various isotopes for visualization of tumors and organs is reviewed and the diagnostic accuracy of the methods are evaluated. (BBB)

17698 A DEVICE IN MOVING-BEAM X-RAY THERAPY (MOVING-GRID THERAPY). Kinichiro Hamasato (Nagasaki Univ.). Nagasaki Igakkai Zasshi, 37: 427-39 (Dec. 1962). (In Japanese)

Techniques for dose reduction and organ shielding were explored in pendulum irradiation of deep-seated tumors with a conventional x-ray-therapy machine. Attempts were made to diminish the volume dose outside the tumor-bearing area by mounting on the x-ray tube cone a grid (Pb strips 5 mm wide and slits 5 mm wide). The grid was placed so that its slits were parallel to the plane of pendulum movement. An elliptic cylindroid Mix-D phantom (cross-section 25 × 30 cm) was subjected to the pendulum irradiation with 250-kvp x rays, filtered through Cu and Al plates 1 mm thick. The axis of rotation corresponded to that of a cylindroid and the size of field was 10 × 10 cm at the axis. The depth doses within the phantom on a plane perpendicular to the rotation axis at its middle point were measured employing a dosimeter, and from these doses,

relative values of volume dose were estimated. The results showed that the shape of assumed tumor area (cross-section of the cylindrical volume continuously irradiated during pendulum irradiation) conformed approximately to the area where depth doses were 80 to 100% of maximum dose. When compared with nongrid pendulum irradiation, this moving-grid method allowed reduction of the volume dose outside the tumor area as well as total-body volume dose, and accordingly raised the ratio of tumor-to-total body volume dose. To give the same dosage as in nongrid pendulum therapy, to the midpoint of the rotation axis, this moving-grid method required a 2.7 times longer period of irradiation, but the dose measured at the phantom surface during the grid irradiation was only 1.2 times that in the nongrid pendulum method. For selective pendulum irradiation of the parametrial tissues in cervical carcinoma of the uterus, a Pb shield was mounted on the x-ray tube cone to shield the bladder and rectum. The measurement of depth dose in the phantom revealed that the moving-grid therapy achieves this shielding more effectively as compared with ordinary nongrid pendulum irradiation. (BBB)

17699 STUDIES ON ABSORBED DOSE OF CRITICAL ORGAN FOR ALPHA-EMITTER. I. ELIMINATION OF ^{228}Ra FROM CRITICAL ORGANS OF THOROTRAST PATIENTS BY MEANS OF ALPHA-ENERGY SPECTROMETRY WITH USING A GRIDDED IONIZATION CHAMBER. Yoshio Katō (National Inst. Radiological Sciences, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 871-8 (Oct. 1963). (In Japanese)

The relative activities of each daughter of ^{232}Th in thorotrast at the time of injection and the elimination of ^{228}Ra from the liver and spleen of thorotrast patients were determined by a technique of α spectrometry using a gridded ionization chamber. The thorotrast consisted of ^{232}Th in equilibrium with ^{228}Th and was free from other daughters at its manufactured date. On expiration, 6 years after manufacture, the relative activities of ^{228}Ra, ^{228}Ac, ^{228}Th, and each daughter of ^{228}Th were 0.461, 0.461, 0.401, and 0.401, respectively. The thorotrast used in this experiment contained a considerable amount of ^{230}Th, but thorotrasts in organs of patients contained very little of it. Effective decay constants of ^{228}Ra in liver and spleen were estimated assuming that Th remains indefinitely in these organs. Since the time interval between the manufactured date of the thorotrast and its injection date could not be known, the calculation was carried out assuming that the thorotrast was injected at its manufactured date or its expiration date. The effective decay constant of ^{228}Ra was 0.183 or 0.187/yr in liver and 0.192 or 0.196/yr in spleen. (from NSA of Japan)

17700 ^{131}I THERAPY OF HYPERTHYROIDISM. I. THYROIDAL UPTAKE MEASUREMENT IN ^{131}I THERAPEUTIC DOSE. Yukio Tateno (Chiba Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 983-6(Nov. 1963). (In Japanese)

Five methods of decreasing the counting rate to improve the accuracy of thyroid-uptake measurements of therapeutic doses of ^{131}I were examined clinically and experimentally using a phantom. The methods studied were: using a thicker (1.25 cm Pb) A-filter; measurement at a farther distance (150 cm); putting a suitable inverted cone into the collimator; measuring the 637 ± 30 kev peak; and making the window of the photo peak narrower (364 ± 5 kev). It was concluded that measuring at a farther distance was the most accurate method when a differential counting method is used and body background is subtracted with a B-filter. (from NSA of Japan)

17701 ^{131}I THERAPY OF HYPERTHYROIDISM. II. THYROIDAL UPTAKE RATE AND EFFECTIVE HALF LIFE IN ^{131}I THERAPEUTIC DOSE. Hirotake Kakehi and Noboru Arimizu (Chiba Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 987-90(Nov. 1963). (In Japanese)

A new method for directly calibrating the thyroidal uptake rate and the effective half life therapeutic dose of ^{131}I is described. Results of the examination of 52 patients with hyperthyroidism treated with ^{131}I are reported. The mean value of the 24-hr uptakes in therapeutic doses was 48%, while that of diagnostic doses measured on the day before therapy was 58%. The difference between the uptakes of therapeutic and diagnostic doses was 10% in mean value, and the standard deviation was 15%. The same relation was shown in 3-hr uptakes. The effective half life of a therapeutic dose differed from that of the diagnostic dose in each case, being shorter in many cases. Radiotherapy shortened the effective half life. The mean value of the first therapy group was 5.3 days, the second 4.5 days, and the third 3.3 days. The variations were considerable in all groups. The direct measurements of uptake and effective half life of the therapeutic dose are very important for accurately determining the dose. (from NSA of Japan)

17702 STUDIES ON THE INTEGRAL DOSE. 1ST REPORT. CALCULATION OF THE INTEGRAL DOSE OF THE WHOLE BODY AT 200 kv X-RAY WITH WORTHLEY AND WHEATLEY'S S (X). Goro Nakamichi (Sendai Railway Hospital) and Nobuo Yamashita. Nippon Igaku Hoshasen Gakkai Zasshi, 23: 1053-7(Dec. 1963). (In Japanese)

Dose distribution was divided into primary and scattered beams, and the integral dose of the whole body was summed for both beams. Scattered dose distribution was obtained by Worthley and Wheatley's S (x) and Johns' Scatter Function, but x was limited between 0 and 2.5. The integral dose of the primary beam was determined and that of the scattered dose was approximated. The integral dose of the whole body was calculated from the above-mentioned data under the following conditions: F. S. D. 50 cm, H. V. L. 1.5 mm Cu, the radius of field size from 1 to 4 cm, and the body section assumed to be an ellipse of 20 to 30 cm. The values calculated by this method were about 10 to 35% larger than the values by Maymeord's Formula. (from NSA of Japan)

17703 SCINTILLATION SCANNING IN CLINICAL MEDICINE. Margaret Beach Glos. Nucleonics, 22: No. 4, 72-5(Apr. 1964).

The use of scintillation scanning to obtain diagnostic information about tumor growth and organ malfunction is discussed. Radiodiagnosis of the lungs, thyroid, bones, and brain by means of compounds labeled with ^{131}I, ^{57}Co, ^{75}Se, ^{18}F, ^{87m}Sr, and ^{197}Hg is considered. (C.E.S.)

17704 COBALT-60 IRRADIATOR FOR EXTRACORPOREAL BLOOD IRRADIATION. O. A. Kuhl, W. Ripperger, D. W. Huszagh, and E. P. Cronkite (Brookhaven National Lab., Upton, N. Y.). Nucleonics, 22: No. 4, 79-80; 82-3 (Apr. 1964). (BNL-7161)

The design and operation of a portable cobalt-60 irradiator for extracorporeal blood irradiation are discussed. The irradiator is useful in the management and study of leukemia. (C.E.S.)

17705 EFFECTS OF RADIOPHOSPHORUS THERAPY POLYCYTHEMIA VERA. Sandor Fazakas, Gyorgy Nagy, and Gyula Petranyi (Debreceni Orvostudominyi Egyetem, Debrecen, Hungary). Orv. Hetilap, 104: 214-16(Feb. 3, 1963). (In Hungarian)

Hematologic changes following ^{32}P treatment are described. (BBB)

17706 SOME METHODS OF THERAPEUTIC AND PROPHYLACTIC MEASURES INVOLVED IN THE POST IRRADIATION COMPLICATIONS. S. M. Szczeglow. Polski Przeglad Radiol. i Med. Nuklearnej, 28: 83-8(Jan. 1964). (In Polish)

Liver and bone marrow preparations demonstrate inductive action upon the hemopoietic reactions of the irradiated organism; moreover, the natural resistance of the organism is aroused. The liver and bone marrow preparations may be used for the prophylactic and therapeutic measures of post-irradiation disease in patients who have undergone heavy irradiation in the course of radiotherapy of neoplastic tumours. (auth)

17707 THE THREAT OF IRRADIATION FOR THE PATIENT AND THE RADIOLOGIC STAFF IN THE COURSE OF PERFORMING OF STEREOTACTIC PROCEDURES OF THE BRAIN WITH GUIOT-GILLINGHAM METHOD. Stanislaw Kwiecinski and Ryszard Chrzanowski. Polski Przeglad Radiol. i Med. Nuklearnej, 28: 91-7(Jan. 1964). (In Polish)

The problem of irradiation of the patient and the radiologic staff in the course of the stereotactic procedures of the brain, performed in the therapy of involuntary movements, is presented. The patient's head receives an irradiation equal to 26 r. The surgeon's hands are mostly threatened in the period of localization of the electrode under radiologic control (with the use of an electronic amplifier it averages to 150 mr). In order to decrease the degree of irradiation, the use of higher values of voltage and lower values of current is suggested together with reduced illumination of the operative room and a good adaptation of sight before the manipulations. (auth)

17708 BIOPHYSICAL ASPECTS OF THERAPY WITH HIGH-ENERGY RADIATION. Felix Wachsmann and Mario Pini (Universität Erlangen, Nuremburg). Radiazioni Alta Energia, 1: 67-90(Apr. 1962). (In Italian)

A review of fundamentals and applications to therapy cites 100 references. Discussion of the physical basis of radiation includes discussion of ionization density and linear energy transfer for electrons, x rays, and heavier particles. The production of ion pairs by the particles is mentioned, particularly in tissues; different absorption in tissues with different atomic numbers, γ,n processes, and effects of impulses are outlined. Differences in biological action of high energy radiation are discussed in relation to RBE; dependence of radiation reactions on time, intrinsic conditions in the subject, method of administration of the dose, and differences between conventional and high-energy radiation in biological effects all enter into RBE. Some different radiation effects in biological subjects include those on mutations, death in bacteria, action on the testes, hemopoietic organs, human skin, death of higher animals, and experimental tumors. In radiotherapy these considerations demand better macroscopic spatial distribution of dose. RBE may act in radiotherapy, if there is increased electivity for tumors. A few considerations of the way it acts are sketched. (BBB)

17709 APPLICATIONS OF HUMAN WHOLE BODY COUNTERS IN NUCLEAR MEDICINE. Teruo Nagai (National Inst. of Radiological Sciences, Chiba, Japan). Radioisotopes (Tokyo), 12: 301-10(Aug. 1963).

Human whole-body counters were employed in clinical tracer studies for measuring the whole-body retention and absorption of very low levels of isotopes and labeled compounds, including $Na^{131}I$, ^{85}Sr, ^{22}Na, ^{51}Cr-labeled red cells, ^{59}Fe, and ^{60}Co-labeled VB_{12}. The results illustrate the potentialities of whole-body counting in clinical diagnosis. Naturally radioactive ^{40}K, ~ 0.0119% of the total K in the human body, can be measured without any isotope ingestion using a human counter. Measurement of the total body K gives important information on physiological and pathological body conditions such as muscular development, lean body mass to fat ratio, and electrolyte balance. The total-body K in patients with periodic paralysis was measured to determine its relation to gross body composition. There was no significant difference between the lean body mass content of K in the periodic paralysis patients and that in control subjects. There was a poor correlation of the total body K with gross body weight and a much better correlation in both groups if the total body K is related to the lean body mass. Human whole-body counters may play an important role in establishing the diagnosis of the neuromuscular diseases associated with K deficiencies and some hormonal diseases that cause disturbance of fat metabolism. (from NSA of Japan)

17710 INTRALYMPHATIC RADIOISOTOPE THERAPY. David M. Seitzman, Fouad A. Halaby, Paul Flanagan, Robert Wright, and James H. Freeman (Walter Reed General Hospital, Washington, D. C.). Surg. Gynecol. Obstet., 118: 52-8(Jan. 1964).

Methods and a vehicle for introducing a radiation source into the lymphatic system, for the treatment of metastasizing cancer, are described, as well as the effects of local irradiation of lymph nodes by these methods. Ethiodol, an ethyl ester of poppy seed oil containing 37% iodine, a portion of which was replaced with ^{131}I, was found to be ideal for intralymphatic therapy. To evaluate the hazards and effects of ethiodol-^{131}I prior to its clinical use, a study was made in 15 terminal patients. Its distribution is followed by roentgenography as well as by scintillation scans. For three days before the lymphangiogram, these patients received 20 drops of Lugol's solution four times a day to block the thyroid. There were no adverse effects noted on the hematopoietic system. Iodine and iodides were released slowly into the systemic circulation and the effective half life of the isotope within the lymphatic system was relatively long. This was verified by mixing a tracer dose of ethiodol-^{131}I with standard ethiodol and performing a routine lymphangiogram. The patient was placed in a whole-body counter and determinations of radioactivity were obtained every two days. The effective half life for ethiodol-^{131}I was 5.8 days. Postmortem examination showed no significant uptake of radioactivity in the thyroid, lung, liver, or kidney. The short penetrating ability of the β particle (maximum tissue penetration 2 mm) allowed large amounts of radiation, up to 37,000 r, to be delivered to an individual lymph node with little, if any, tissue reaction outside of it. Determination of dose was based upon two factors: 9 to 12 cm^3 of ethiodol filled the retroperitoneal lymphatic system without appreciably filling the thoracic duct; if over 30 mC are given, isolation precautions should be employed. Therefore, ethiodol-^{131}I assaying at 2.5 mC/cm^3 providing a total of 22.5 to 30 mC is used. In every patient who received ethiodol-^{131}I, the lymph nodes demonstrated varying degrees of destruction of the cortical and medullary lymphocytic tissue. In those who received the smaller doses (3.5 mC), the architecture was moderately altered. The changes were greater in those patients who received higher doses of radiation (up to 33 mC). Their lymph nodes showed almost complete lysis of the primary and germinal follicles and depopulation of the histiocytes

and lymphocytes in the medulla. Late changes from irradiation, such as fibrosis and hyalinization, were not seen, and in spite of these high levels of radiation, there was little, if any, histologic effect of radiation beyond the capsule of the lymph node, due to the short penetrating ability of the β particle. The effect of the radiation upon the tumor within the lymph nodes was impossible to evaluate. (BBB)

17711 ON THE TREATMENT OF VEGETATIVE RADIATION REACTIONS. Frank Leichsenring (Roentgen- und Strahlenabteilung des Allgemeinen Krankenhauses Altona, Hamburg). Therap. Gegenwart, 101: 292-4(June 1962). (In German)

X radiation administered to the region of the spinal cord near the vegetative nerve paths and autonomic ganglia can lead to headache, anorexia, nausea, and symptoms characteristic of hypochloremia. The appearance of these effects is directly related to the frequency and intensity of the radiation treatment, and can produce apprehension to the point of a radiation depression in psychically labile patients. This may reflexly trigger a reaction and spontaneous appearance of the symptoms for any subsequent radiation treatment. A phenothiazine derivative, 10-(3-dimethylaminopropyl)-2-(trifluormethyl)-phenothiazine hydrochloride, called Psyquil, was tested in 30 patients with various types of cancer to reduce apprehension by sedation or emotional suppression, and to lower the sensitivity to radiation by increasing the threshold of stimulation for nerve centers IX and X, located in the pars medullaris of the reticular region. The symptoms appeared from 8 to 10 days after the daily radiation treatments were started. Psyquil was administered as a tablet or injected intravenously or intramuscularly, or in a combination of oral and parenteral administration. By parenteral administration it was possible to bypass the gastrointestinal tract and avoid any disturbance in absorption that the radiation may have produced. Oral dosage had very high antiemetic effects. A maintenance dosage is 10 mg given three times a day before mealtimes. The intensity of symptoms, but not the type of cancer, should govern the administration of the drug. Side effects consisted of occasional drowsiness, and no deleterious effects were observed in kidney, blood, or blood pressure. No indications of parkinsonianism were seen at the dosage recommended. Psyquil is not effective in advanced states of uremia. (BBB)

17712 SURGICAL TREATMENT OF CANCER OF THE NOSE. Claude C. Coleman, Jr., and A. A. Khuri (Univ. of Virginia, Charlottesville). Virginia Med. Monthly, 90: 258-63(June 1963).

Repair of disfigurement of the nose following radiotherapy or surgery for cancer of the nose is described. It is suggested that simple excision and primary closure will usually cure early cancer of the nose. However, after radiation and/or inadequate surgery, the treatment often demands extensive surgery and complex reconstruction. The use of radiotherapy in the treatment of cancers of the tip of the nose has a very narrow margin of safety. In order to effect a cure, the therapist must deliver sufficient radiation to skin which is scarcely separable from the underlying cartilages. Therefore, radionecrosis of the skin and cartilages is frequently the result of a method of therapy which has theoretical advantages over surgery. Frequently cancer persists in patients who have had sufficient radiation to totally destroy all or part of the tip of the nose. Another deterrent to the use of radiation in these patients is that often cancer is induced in areas far removed from the area under treatment. Results in the 44 cases described indicate that small cancers of the nose, regardless of their location, can be cured by simple excision with primary closure. (BBB)

17713 THE YEAR BOOK OF RADIOLOGY (1963-1964 YEAR BOOK SERIES). RADIOLOGIC DIAGNOSIS. John Floyd Holt and Walter M. Whitehouse, eds. RADIATION THERAPY. Harold W. Jacox and Morton M. Kligerman, eds. Chicago, Year Book Medical Publishers, Inc., 1964. 432p.

Summaries and editorial comments are presented for recent publications from the world's foremost medical journals covering radiologic diagnosis and radiation therapy. Emphasis is placed on improvements in techniques. Part I. Topics discussed include applications of television technology to clinical radiologic problems, the use of tape recorders for recording and replaying of television fluoroscopic presentations, recent advances in cineradiography, the efficiency of various systems for amplification of roentgen images and data recording systems for roentgen data, the development of vascular contrast techniques for use in microangiography and other critical areas, procedures for vascular, cardiac, gallbladder, colonic, and other contrast studies, lymphangiography, mammography, infrared thermographic scanning of the breast for neoplasms, urogenital radiology, and radiologic studies of diseases of genetic origin and neonatal deformities. The relative values of diagnostic radioisotope techniques, particularly in neurosurgical and renal problems, are compared with standard radiologic methods. Part II. Therapeutic applications of radiation in the treatment of malignant and benign tumors and miscellaneous conditions are grouped anatomically. Many articles review the results of treatment for large groups of patients. X radiation and ^{60}Co γ radiation were used routinely. Electron beam, radioisotope, and chemical therapy of tumors are also discussed. Results are reported from radiobiological studies of interest to radiologists. Physical characteristics of various radiotherapy units, dosimetry techniques, and radiation hazards and injuries are covered. Author and subject indexes are included. (C.H.)

CHEMISTRY

General

17714 (ANL-6725) CHEMICAL ENGINEERING DIVISION SUMMARY REPORT, APRIL–JUNE 1963. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 248p.

Research and development progress in chemical engineering is reported under 9 topics. Separate abstracts were prepared for each topic. (M.C.G.)

For abstracts of individual chapters see: 17769, 17770, 17921, 17922, 17923, 17924, 18615, 18862, and 19309.

17715 (BM-RI-6323) REMOVAL OF HYDROCARBONS AND CARBON MONOXIDE FROM AUTOMOTIVE EXHAUST, USING A PROMOTED URANIUM CATALYST. D. Bienstock, R. C. Kurtzrock, E. R. Bauer, Jr., and J. H. Field (Bureau of Mines. Pittsburgh Coal Research Center). Oct. 1962. 21p.

To remove hydrocarbons and carbon monixide in automotive exhaust by oxidation, a cataylst of 4.2 percent U_3O_8, 1.7 percent Cr_2O_3, and 1.7 percent CuO supported on $\frac{1}{8}$-inch γ-alumina spheres was tested in a reactor in place of the muffler of a $\frac{1}{2}$-ton truck. Tests were made with both nonleaded and leaded gasolines. With the engine at operating temperature, tests were made with the engine idling and with the vehicle cruising at 30 mph. Auxliary air was added to maintain an oxygen concentration of 3 to 4 percent in the gas leaving the catalytic reactor. The vehicle was operated for 83 hours (about 60 percent of the time with the engine idling) and 525 miles with nonleaded gasoline. Conversions of 98 percent of the hydrocarbons and 100 percent of the carbon monoxide were achieved with the engine idling and with 7,000 ppm carbon atoms and 4-percent carbon monoxide in the feed to the reactor. Hydrocarbon conversions of 75 percent were obtained at crusing speeds of 30 mph with a feed of 1,700 ppm carbon atoms; the carbon monoxide concentration was less than 0.3 percent in the feed and was unchanged in passage through the reactor. Identical activity was obtained initially in switching to a gasoline containing 1.9 ml tetraethyl lead (TEL) per gallon. However, there was a gradual loss in activity thereafter. Conversions in tests with the engine idling about 50 percent of the time, had decreased by 23 percent for the hydrocarbons and by 25 percent for the carbon monoxide from their initial values after 122 hours and 1,300 miles of operation with leaded gasoline. The levels of radioactive materials in the exhaust of the reactor and the radiation in the vehicle were negligible. (auth)

17716 (NP-13766) COMPTE-RENDU DU COLLOQUE DE EAU LOURDE (J.E.N. MADRID, DECEMBRE 13-14, 1962). (Report of the Colloquium on Heavy Water (Council of Nuclear Energy, Madrid, Dec. 13-14, 1962)). (Spain. Junta de Energia Nuclear, Madrid and European Atomic Energy Society, Paris). 172p.

Separate abstracts were prepared for the ten papers on the production, use, analysis, reconcentration, and determination of heavy water. (D.C.W.)

For abstracts of individual papers see: 17726, 17727, 17775, 17776, 17777, 18257, 18258, 18259, 18260, and 18261.

17717 (TID-20438) THE THERMODYNAMICS AND KINETICS OF COORDINATION COMPOUNDS. Progress Report. Michael Cefola and Philip S. Gentile (Fordham Univ., New York). Feb. 14, 1964. Contract AT(30-1)-906. 37p.

The kinetics of formation of copper and nickel acetylacetones were measured. Studies were begun on the reactions of Zn, Mn, and Co with acetylacetone and glutamic acid. Stability constants of complex formation between ^{24}Ni and acetylacetone at 0, 25, and 40°C were obtained in mixed solvents in the dielectric range of 80–30. Diketone complexes were irradiated with fast and slow neutrons as well as with ultraviolet light in an attempt to evaluate the amount of decomposition and fragments of decomposition as well as the mechanism of the breakdown process. The isolation of coordination compounds of divalent and trivalent metals with diacetamide is reported. The solubility behavior of tetrathiocyanatocobaltomercuriate(II) in mixed solvent systems was investigated. Isotope effects on the dissociation constant of d-2,4-pentanedione in totally deuterated systems of methanol-water were determined. (M.C.G.)

17718 (UCRL-11046(p.152-8)) STRUCTURE AND MECHANISM OF HYDROLYSIS OF THE PRODUCT OF REACTION OF P_2O_5 AND ETHYL ETHER. Gilbert Weill, Melvin P. Klein, and Melvin Calvin (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry).

The structure and mechanism of hydrolysis of the product of the reaction of P_2O_5 and ethyl ether, which has the composition of a metaphosphate ester $[PO_3(C_2H_5)]_n$, was investigated by a nuclear magnetic resonance technique. Data are presented on the spectrum of the polymetaphosphate ester in chloroform, in the absence of water, and using ethanol as an additive in the place of water. (C.H.)

17719 THE SOLUBILITIES OF TBP IN SEVERAL KINDS OF AQUEOUS SOLUTIONS. Tadashi Nagumo (Asahi Chemical Industry Co., Tokyo). Kogyo Kagaku Zasshi, 66: 1009-10(1963).

The synthesis of tributyl phosphate (TBP), a heavy-metal chelating agent, labeled with ^{32}P is described. The solubilities of TBP in the aqueous solutions of nitric acid, sulfuric acid, ammonium nitrate, sodium hydroxide, and ammonia were measured. TBP was dissolved in n-hexane. Solubilities obtained in each solution using 20 vol % of TBP in n-hexane were as follows: 6×10^{-3}% (v/v) in 4 to 9N nitric acid, 5×10^{-3}% in 6 to 9N sulfuric acid, and 1×10^{-2}% in 2N sodium hydroxide. (BBB)

Analytical Procedures

17720 (BM-RI-6414) ANALYSIS OF HIGH-PURITY COLUMBIUM BY OPTICAL EMISSION SPECTROGRAPHY. Lloyd Carpenter and James M. Nishi (Bureau of Mines. Boulder City Metallurgy Research Lab., Nev.). Sept. 1963. 18p.

Sixteen elements were determined spectrochemically in the general range of 3 to 1,000 ppm in high purity Nb. Samples were converted thermally to Nb_2O_5, mixed with graphite and GeO_2, and excited for 15 seconds using a 15-ampere d-c arc. For the molybdenum determination, the oxidized samples were mixed with NaCl and GeO_2 and excited for 30 seconds. Spectra were recorded on photographic plates, and spectral line transmittance values were measured photometrically. Relative-intensity ratios of selected analytical and internal standard spectral lines were plotted against

concentrations of standards to form curves from which concentrations of impurities were read. Average precision of the method was 11.2 percent relative standard deviation. (auth)

17721 (BNL-7885) COMPUTER ANALYSIS OF GAMMA-RAY SPECTRAL DATA IN THE DETERMINATION OF BODY BURDENS OF RADIONUCLIDES. S. H. Cohn and E. A. Gusmano (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 17p. (CONF-448-2)

For Presentation at the IAEA Symposium of the Assessment of Radioactive Body Burdens in Man, Heidelberg, Ger., May 1964.

The technique of gamma-ray measurement by pulse-height analysis provides the most rapid and accurate determination of internally deposited radionuclide abundances in man. Scintillation spectrometer pulse-height distribution data were analyzed to quantify the levels of ^{137}Cs, ^{65}Zn, ^{40}K, and other radionuclides in several hundred subjects. Automatic data-handling techniques, including computer analysis of the spectral data, were employed. The whole-body counter data of the subjects were compared with those obtained from a phantom (REMAB) containing standardized solutions of a number of monoenergetic gamma emitters. A number of FORTRAN II programs for the IBM-7094 were used for the reduction of the pulse-height distribution data. The programs first perform a non-linear least-squares fit of a Gaussian function to the data points in the spectrum photopeaks. The associated Compton distribution required in the stripping program is then compared by interpolation from an experimentally derived matrix of seven monoenergetic gamma rays. Commencing with the highest energy, each designated photopeak and its associated Compton is subtracted off until the complex spectrum is analyzed. Other programs take the initial spectral data from the analyzer in the form of punched paper tape and convert it to magnetic tape for use in the above stripping programs. This technique described appears capable of providing rapid and accurate quantitative interpretation of pulse-height distribution data, applicable to the determination of body burdens of various radionuclides. It was shown that the method is less subjective than the usual graphic method for interpreting spectral data. The accuracy attainable and limitations of this computer analysis are discussed along with the results of specific population surveys for estimating body burdens. (auth)

17722 (HW-SA-3337) RADIOCHEMICAL DETERMINATION OF PLUTONIUM FOR RADIOLOGICAL PURPOSES. Julian M. Nielsen and Thomas M. Beasley (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [1963]. Contract AT(45-1)-1350. 23p. (CONF-448-1)

For Presentation at IAEA Symposium of the Assessment of Radioactive Body Burdens in Man, Heidelberg, Ger., May 1964.

A review is presented of the procedures that have been and are currently being used for the determination of micro-microgram quantities of plutonium in biological and environmental samples. Special emphasis is placed on excretion analysis. Expected urinary excretion rates have been calculated using assumed levels of plutonium deposition so that the analytical sensitivities of various procedures can be compared. Complete dissolution of excreta, soil, bone, tissue, and vegetation are described with emphasis on avoiding the formation of refractory compounds of plutonium which are difficultly soluble. Analytical methods for plutonium analysis of these materials are reviewed and include coprecipitation, liquid-liquid extraction, ion exchange chromatography and the use of plutonium isotopes for yield determinations by means of alpha energy analysis. Using counting statistics, comparisons are made of the sensitivities available in low level alpha counting using ionization chambers, proportional counters, diode counters, and nuclear track emulsions. Isotopic analysis of plutonium by alpha spectrometry, nuclear emulsion techniques, and liquid scintillation counting are included. The use of non-isotopic carriers as a source of extraneous activity and the environmental levels of plutonium recently encountered around the world are discussed in connection with "blank" samples. Two possibilities are considered for future methods of plutonium analysis where increased sensitivity is required. These are activation analysis and fission fragment counting. (auth)

17723 (IDO-12034) PRECIPITATION OF SUBMICROGRAM QUANTITIES OF THORIUM BY BARIUM SULFATE. APPLICATION TO THE FLUOROMETRIC DETERMINATION OF THORIUM IN MINERALOGICAL AND BIOLOGICAL SAMPLES. Claude W. Sill and Conrad P. Willis (Idaho Operations Office. Health and Safety Div., AEC). Dec. 1963. 42p.

Investigations of the toxicology and mineralogy of thorium requires its determination at extremely low concentrations in many kinds of biological and mineralogical materials. An efficient method is required for separation of thorium from the relatively large samples employed. The present investigation has shown that thorium is precipitated by insoluble metallic sulfates and that the process is extremely efficient and reliable. Precipitation of 25 mg of barium as sulfate will separate greater than 99.5% of the thorium from 100 μg down to at least 10^{-5} μg from 75-ml volume. Since the fluorometric procedure to be used with the present separation will not measure more than 5 μg, the range is highly satisfactory. The separation takes place from strongly acidic solutions containing high concentrations of alkali metal sulfates and is not affected by concentration or type of acid, temperature of precipitation or length of digestion, or presence of high concentrations of most other elements including phosphates. Pyrosulfate fusion is employed for dissolution of various kinds of refractory materials including thorium itself. The aqueous filtrate from the barium sulfate precipitation contains most of the other components of the sample and is discarded. The barium sulfate is dissolved in alkaline DTPA and the thorium is determined directly in the alkaline solution by the fluorometric procedure previously described. The effect of experimental conditions and most of the elements of the periodic table on the recovery of thorium have been checked exhaustively using 2×10^5 cpm of thorium-234 as tracer. Also, the procedure has been checked to ensure adequate separation of other elements that might interfere with the fluorometric determination. The procedure has been applied to the following types of samples with the detection limits indicated: rocks, 2×10^{-6}%; bone ash, 5×10^{-7}%; feces, liver, and grain, 2×10^{-6}%; urine, 10^{-11} g/ml; and blood, 2×10^{-10} g/ml. (auth)

17724 (JAERI-4026) DETERMINATION OF TRACE ELEMENTS IN THORIUM. (Japan Atomic Energy Research Inst., Tokyo). Dec. 1963. 124p. (In Japanese)

Given are the chemical analysis methods and spectrographic analysis methods which were presented to "Thorium Analysis Committee, Japan Society of Newer Metals" for the trace impurities in thorium and thorium

compounds. Suggested and tested chemical methods for Ag, Al, B, Cd, Cl, Co, Cr, Cu, Fe, Li, Mn, Mo, Ni, P, Pb, total rare earth elements, and individual rare earth elements are described. Spectrographic methods involve the carrier-distillation method, copper spark method, and oxygen-atmosphere direct current arc method for rare earth elements. Comparison data of the analytical results between participating laboratories in the committee are also presented. The subjects of the presented articles to the committee are also listed. (auth)

17725 (LA-3049) THE GRAVIMETRIC DETERMINATION OF TRACE AMOUNTS OF HYDROGEN IN SODIUM METAL. Ross D. Gardner and William H. Ashley (Los Alamos Scientific Lab., N. Mex.). Feb. 1964. Contract W-7405-eng-36. 12p.

The classical combustion-gravimetric method for the determination of hydrogen was modified and applied to the measurement of trace amounts of hydrogen in sodium metal. The sample, contained in an aluminum capsule, was reacted with a flux of silica sand at 1000°C in an atmosphere of argon. Following this, the combustion was completed in an atmosphere of oxygen. The resulting water was absorbed in $Mg(ClO_4)_2$ and weighed. An average recovery of 100% with a standard deviation of 8 ppm was obtained for the analysis of 50 samples containing known amounts of hydrogen in the 0 to 600 ppm range. (auth)

17726 (NP-13766(p.135-54)) L'ANALYSE DE L'EAU LOURDE EN VUE DE SA PREPARATION ET DE SON UTILISATION DANS LES REACTEURS NUCLEAIRES. (Analysis of Heavy Water in View of its Preparation and Use in Nuclear Reactors.). E. Roth (Spain. Junta de Energia Nuclear, Madrid and European Atomic Energy Society, Paris).

Infrared absorption, densimetric, mass spectrometric, thermal conductivity, and gas chromatographic techniques and equipment for the analysis of heavy water during its preparation and use are described. The particular areas of usefulness of each technique are indicated, and typical results are included. (D.C.W.)

17727 (NP-13766(p.155-68)) THE "TWO-IMAGE FLOAT" METHOD AT TEMPERATURE BELOW 25°C. J. L. Otero, M. Gispert, and J. L. Rojas (Spain. Junta de Energia Nuclear, Madrid and European Atomic Energy Society, Paris).

A float method for the densimetric determination of D_2O in liquid samples is described. An improved apparatus (described) was constructed. The results of analyses of known and unknown samples at 4 to 25°C and of an investigation of the precision of the method are discussed. A sensitivity of ±6 ppm at 25°C and 0.2 ppm/0.001°C at 6°C was obtained. The best working temperature is about 8–12°C, and determination times range from about 20 min at 25°C to 45 min at 6°C. (D.C.W.)

17728 (PG-Report-546) ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF ZIRCONIUM IN IRON/ALUMINIUM ALLOY. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1964. 9p.

A portion of the sample is dissolved in hydrochloric acid and the solution oxidized with nitric acid. Zirconium phosphate is then precipitated in conditions of controlled acidity. After separation by filtration, the precipitate is ignited and fused with sodium carbonate. The melt is leached with water and the insoluble zirconium compound separated by filtration. This is finally taken into solution in dilute hydrochloric acid and the zirconium determined absorptiometrically, on an aliquot as the lake with alizarin red S. The method is suitable for the determination of zirconium in the range 0.1 to 0.45%, but this may be extended by using a reduced weight of the sample. The results of duplicate determinations on four different samples at the 0.18 to 0.20% level indicate that the standard deviation is of the order ±0.005%. 0.1%, 0.2%, and 0.3% zirconium ion added to solutions of zirconium-free iron/aluminum alloy gave recoveries of 96, 97, and 100% respectively. (auth)

17729 (PG-Report-564) ANALYTICAL METHOD FOR THE DETERMINATION OF MOLYBDENUM-99. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1964. 6p.

The radiomolybdenum with added carrier is precipitated with α benzoin oxime, fission products contaminating it are removed, and finally the molybdenum is obtained as lead molybdate. The beta activity of the precipitate is measured. The method is suitable for determining molybdenum-99 in fresh fission products in the presence of uranium and plutonium and could be used in assessing the magnitude of a criticality incident. (auth)

17730 (PG-Report-569) ANALYTICAL METHOD FOR THE DETERMINATION OF BORON IN GASEOUS CARBON DIOXIDE. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1964. 6p.

Gaseous carbon dioxide is mixed with oxygen and passed through a heated silica combustion tube. The oxidized boron compounds are collected on the cooler part of the silica tube and in a small absorber vessel containing hydrogen peroxide solution. The contents of the absorber and tube washings are combined and evaporated to dryness in the presence of sodium hydroxide. Curcumin and a mixture of sulphuric acid and acetic acid are added and the boron curcumin complex is dissolved in ethyl alcohol. The boron content of the solution is determined absorptiometrically. This method is intended for use on high purity carbon dioxide supplied as coolant for nuclear reactors of the Calder Hall or A.G.R. types. (auth)

17731 (PG-Report-576) ANALYTICAL METHOD FOR THE DETERMINATION OF TRI-BUTYL PHOSPHATE IN ACTIVE AND NON-ACTIVE MIXTURES OF TBP/KEROSENE. Acid Equilibration Method. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1964. 3p.

Traces of mono-butyl phosphate, di-butyl phosphate, and free acids are removed by neutralizing the solution with sodium hydroxide solution and discarding the aqueous phase produced. The sample is then shaken with standard nitric acid solution until equilibrium is established, and the concentration of acid in the organic phase is determined as a measure of the concentration of the tri-butyl phosphate in the sample. The exact concentration is obtained from a graph prepared from standard mixtures. The method should be free from bias. Three times the coefficient of variation is 1.5%, determined by 29 operators at a level of 19 to 21% of tri-butyl phosphate. The normal concentration range of use is 10 to 30% v/v tri-butyl phosphate in kerosene. The limit of detection is 0.2% v/v tri-butyl phosphate. The method is suitable for the determination of tri-butyl phosphate in the tri-butyl phosphate/odorless kerosene feed to the separation plant and in the washed solvent for recycling. It is satisfactory in the presence of traces of mono-butyl phosphate and di-butyl phosphate, but 0.5% v/v each of these compounds leads to a bias of +1%. For larger amounts of mono-butyl phosphate and di-butyl phosphate, a correction must be made for the volume change occurring in the washing procedure. (auth)

17732 (CEA-tr-X-537) MÉTHODE DE COMBUSTION-TITRIMÉTRIQUE DE DOSAGE RAPIDE DES TRACES DE CARBONE DANS L'URANIUM MÉTALLIQUE, DANS LE TITANE ET DANS LES FONTES ET ACIERS. (Combustion-Titrimetric Method for Rapid Determination of Traces of Carbon in Metallic Uranium, in Titanium, and in Irons and Steels). I. Fujishima and T. Takeuchi. Translated into French from Bunseki Kagaku, 10: 1221-5 (1961). 24p. (Includes original, 5p.).

A method by which traces of carbon (40-500 ppm) can be determined in less than 10 min with a precision of 1.2 to 2.0 ppm, using samples of less than 1 g, is described. (D.C.W.)

17733 LIQUID SCINTILLATION COUNTING OF C^{14}-LABELED d-TURBOCURARINE. G. Dal Santo (Metropolitan Hospital, Detroit and Wayne State Univ., Detroit). Acta Isotopica, 3: 5-16(1963).

Principles and advantages of liquid scintillation counting are summarized and methods for the determination of ^{14}C-labeled dimethyl-d-tubocurarine in plasma, urine, CSF, and tissue are reported. (auth)

17734 THE DETERMINATION OF URANIUM IN THE PRESENCE OF PLUTONIUM BY CONTROLLED POTENTIAL COULOMETRY. APPLICATION TO THE ANALYSIS OF FUEL ELEMENT PROCESSING SOLUTIONS. G. C. Goode, J. Herrington, and G. Hall (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Anal. Chim. Acta, 30: 109-13(Feb. 1964).

A controlled potential coulometric method is described for the determination of uranium in the presence of plutonium and iron based on the reduction of uranium(VI) to uranium(IV) at a mercury cathode, after reduction of plutonium to plutonium(III) with hydrazine. The application of this procedure to the analysis of fuel element processing solutions in nitric acid is discussed and a precision of 0.2% was obtained. A brief description of the controlled potential coulometer is given. (auth)

17735 DETERMINATION OF MANGANESE IN URANIUM BY ION EXCHANGE AND SQUARE-WAVE POLAROGRAPHY. Fumito Nakashima (Hitachi Ltd., Hitachi City, Japan). Anal. Chim. Acta, 30: 167-75(Feb. 1964).

Traces of manganese in uranium and its compounds can be determined by ion-exchange separation and square-wave polarography. When a 9 M hydrochloric acid solution of the sample is introduced into a column of strongly basic anion-exchange resin, manganese can be quantitatively separated from uranium by eluting with 9 M hydrochloric acid. The determination of the separated manganese by square-wave polarography is performed in 1 M potassium hydroxide-0.4 M triethanolamine solution with an excellent sensitivity. The lower limit of the method is 0.5 ppm of manganese. (auth)

17736 DETERMINATION OF THORIUM IN ROCKS. THE ARSENAZO III REACTION IN PERCHLORATE MEDIUM. Sydney Abbey (Geological Survey of Canada, Ottawa). Anal. Chim. Acta, 30: 176-87(Feb. 1964).

Arsenazo III was examined for the determination of traces of thorium in rocks. The superior sensitivity and selectivity of the arsenazo III reaction over the thorin reaction was confirmed. Sensitivity and stability were improved by working in a perchlorate medium. Anomalous effects were observed in the presence of relatively large amounts of titanium. Silicate samples are decomposed by Rafter's peroxide sinter, the sinter cake leached with water, and the residue dissolved in acid. Thorium is collected on a calcium oxalate precipitate and determined photometrically in perchlorate medium at 660 mμ. The normal working range is 0 to 25 μg of thorium on a 0.5 g sample. (auth)

17737 DETERMINATION OF CALCIUM, STRONTIUM AND BARIUM IN SINGLE CRYSTALS OF ALKALI HALIDES BY NEUTRON ACTIVATION. Francesco Girardi and Romano Pietra (C.C.R.-Euratom, Ispra, Italy). Anal. Chim. Acta, 30: 188-99(Feb. 1964).

The determination by neutron activation of trace quantities of calcium, strontium, and barium in single crystals of alkali halides was studied. The matrix is eliminated before the irradiation by an ion-exchange procedure. Gamma spectroscopy after radiochemical separation is used to determine strontium and barium. Calcium is determined by measuring the β-activity of ^{49}Sc formed by the decay of ^{49}Ca. Long-lived radioactive tracers are used to determine the chemical yields. (auth)

17738 THE USE OF A DISCHARGE TUBE AS AN ABSORPTION SOURCE FOR THE DETERMINATION OF LITHIUM-6 AND LITHIUM-7 ISOTOPES BY ATOMIC ABSORPTION SPECTROPHOTOMETRY. Joseph A. Goleb and Yu. Yokoyama (Argonne National Lab., Ill.). Anal. Chim. Acta, 30: 213-22(Mar. 1964).

An atomic absorption technique was used to determine the natural abundance ratio $^{7}Li/^{6}Li$, in a normal sample of C.P. grade lithium hydroxide prepared in 1942. The result obtained was 12.1 ± 3.3%. A Schüller-Gollnow water-cooled hollow-cathode tube was used to obtain the resonance doublet of lithium at 6708 Å, while a modified Schüller-Gollnow water-cooled hollow-cathode tube was used to vaporize the natural lithium and related standards in microgram quantities and to absorb the resonance radiation. Helium was used as a carrier gas in both tubes at low pressures for the purpose of sputtering samples and exciting the lithium resonance lines. Regulated d.c. current power supplies, and conventional, independent circulating systems were used with each tube; and a Jarrell-Ash monochromator, Model 82-000, of relatively low dispersion, was used to isolate the resonance lines, along with other readily available commercial recording equipment. (P.C.H.)

17739 SIMULTANEOUS DETERMINATION OF NICKEL AND COBALT TRACES BY NEUTRON ACTIVATION ANALYSIS. R. Malvano and G. B. Fasolo (Societa Richerche Impianti Nucleari, Saluggia, Italy). Anal. Chim. Acta, 30: 223-6(Mar. 1964).

Nickel and cobalt traces may be determined by measuring the ^{58}Co and ^{60}Co activities produced in a nuclear reactor. Solvent extraction of cobalt, and γ spectrometry on the extracted phase allow a rapid and simple analysis of both metals. The method was applied to the determination of nickel (100−0.2 ppm) and cobalt (0.15−0.001 ppm) in various materials (petroleum, polyphenyls, and aluminum). (auth)

17740 SIMULTANEOUS DETERMINATION OF LEAD AND NICKEL IN URANIUM BY SQUARE-WAVE POLAROGRAPHY. Fumito Nakashima (Hitachi Ltd., Hitachi City, Japan). Anal. Chim. Acta, 30: 255-60(Mar. 1964).

A sensitive method for the simultaneous determination of trace lead and nickel in uranium is described. The elements are separated from uranium by anion exchange and then determined by square-wave polarography using the alkaline cyanide solution as supporting electrolyte. The procedure is applicable to uranium metal and its compounds containing as little as 1 ppm of lead and nickel. (auth)

17741 A NEW TECHNIQUE FOR THE DETECTION OF RADIOACTIVE BIOCHEMICALS BY SCINTILLATING ION EXCHANGE RESINS. A. H. Heimbuch and W. J.

Schwarz (Tracerlab Inc., Richmond, Calif.). Atompraxis, 10: 70-4(Feb. 1964).

The present status and future applications of scintillating ion exchange resins are discussed. It has been demonstrated that ^{14}C-tagged amino acids can be adsorbed by the cation resin and counted efficiently. Iodine-131 was removed from milk at a level of 0.5 dpm/ml by the anion resin. Carbon-14 as the carbonate anion has been adsorbed and counted with an efficiency of 35%, thus indicating the potential use of the resin for measuring certain enzyme systems. The problems of oxygen or sample quenching that occur in liquid scintillation counting are eliminated, or certainly minimized, for ionic biological compounds. Sample incompatibility in organic liquid scintillators due to insolubility and difficulties due to low specific activity (dpm/ml of sample) are also overcome for ionic, radioactive constituents by use of the scintillating resins. Other features of the resin are: rapid sample preparation, simple counting apparatus can be used; the activated resin can be counted in aqueous and organic liquids; non-destruction of biological compounds with easy recovery after assay; concentration and detection of extremely low specific activities permits in vivo experimentation without sacrificing the animal; and the necessity of converting organic sulfur-35 and carbon-14 to their respective gases of SO_2 and CO_2 for gas counting techniques can be obviated for those compounds that are adsorbed by ion exchange resins. (P.C.H.)

17742 RAPID ANALYSIS OF TWO-COMPONENT SUBSTANCES AFTER ATTENUATION OF RADIOACTIVE RADIATION. W. Dietzsch (VEB Vakutronik, WIB, Dresden). Atompraxis, 10: 91-8(Feb. 1964). (In German)

The linear attenuation coefficient of a given substance depends upon the composition of the substance. Thus, this latter can be determined by measuring the attenuation of the radiation when it passes through the substance. The sensitivity that can be attained with this procedure, and the requirements that the measurement apparatus must meet are discussed. It is assumed that the two-component substances and the radiation are such that the mass attenuation coefficients of the two components are identical. (auth)

17743 SIMULTANEOUS MEASUREMENT OF TRITIUM AND ^{14}C IN BIOLOGICAL MATERIAL WITH A LIQUID SCINTILLATION COUNTER. K. Hempel (Universität, Cologne). Atompraxis, 10: 148-52(Mar. 1964). (In German)

Work on simultaneous determination of ^{3}H and ^{14}C in dry tissue specimens, using a liquid scintillation counter is reported. Carbon-14 was measured in the form of $^{14}CO_2$, and tritium as TOH. These inorganic compounds can best by obtained from dry organs by combustion in an oxygen atmosphere, using Schöninger's method. A mixture of toluene, ethanol, colamine, PPO, and POPOP was used as a scintillator. The two counting channels of the scintillation counter (TriCarb) were adjusted so that tritium was measured only in one channel, while the counting rate for ^{14}C was the same in both channels. With this set-up, the actual amount of tritium and ^{14}C in the specimen can be determined with a minimum of calculation. Certain possibilities of error in simultaneous measurement of ^{3}H and ^{14}C are discussed. (auth)

17744 ELECTRON-PROBE MICROANALYSIS OF LOW ATOMIC NUMBER ELEMENTS. G. V. T. Ranzetta and V. D. Scott (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Brit. J. Appl. Phys., 15: 263-74(Mar. 1964).

It is shown that electron-probe microanalysis for the low atomic number elements such as oxygen and carbon may be achieved with a commercial instrument by the addition of simple pulse-height analysis equipment. The necessary apparatus comprises a network unit, rate-meters, and pulse-height analyzers, together with a thin-window proportional counter. Results are presented, which demonstrate the detection and separation of carbon, nitrogen, and oxygen x radiations when present with other x rays; the scanning pictures included show the distribution of carbides and oxides in the metals beryllium, iron, and uranium. Some problems concerning contamination of the sample during irradiation by the electron probe and specimen oxidation are discussed with relation to light element microanalysis. The network method may be readily applied to quantitative analysis although difficulties were experienced in obtaining suitable reference standards in light element work. Results are presented for analysis of the respective carbides of silicon, iron, and uranium and are subsequently discussed with relation to correction procedures. The absorption of carbon x radiation is shown to be high in all three compounds, but atomic number effects may differ considerably, being large for carbon–uranium and carbon–iron and small for carbon–silicon. In general, atomic number effects may compensate for x-ray absorption; thus at an operating voltage characteristic for each system, it is possible to measure the correct carbon concentration. (auth)

17745 FLUOROMETRIC DETERMINATION OF URANIUM IN VARIOUS MATERIALS. Evzen Singer and Dagmar Cifkova (Research Inst. for Inorganic Chemistry and Regional Station of Hygiene and Epidemiology, Usti nad Labem, Czechoslovakia). Chem. Listy, 58: 218-23(Feb. 1964).

The determination of uranium materials by fluorometric methods, taking into account the sources of the materials, is discussed. Methods of analysis are compared with other standard methods and their sensitivity and accuracy are discussed. Practical experience with the methods described is presented. Maximum concentrations of U suitable for the given methods are indicated; determination in solutions, dust, ores, and biological materials is described. (OTS)

17746 CONSTRUCTION OF AN OBJECTIVE FLUORIMETER FOR THE MEASURING OF FLUORESCENCE OF MELTS, AND AN APPARATUS FOR THE DETERMINATION OF TRACES OF URANIUM. Evzen Singer, Bohuslav Ruzicka, and Josef Turtenwald (Research Inst. for Inorganic Chemistry, Usti nad Labem, Czechoslovakia). Chem. Listy, 58: 224-30(Feb. 1964).

An apparatus that has been used successfully for some time in the analysis of samples of varying origin is described. The construction of the apparatus is given, and method of working in melted samples is described. 1×10^{-6} to 4×10^{-9} of U in 0.6 grams of melt can be determined. The accuracy in the region 10^{-9} to 10^{-8} is 25%, in the region of 10^{-8} to 10^{-6} is 6%. Individual components of the instrument are described and calibration of the instruments is discussed. Preparation of the samples for analysis is given. (auth)

17747 NON-DESTRUCTIVE DETERMINATION OF In IN METALLIC ALLOYS BY NEUTRON ACTIVATION ANALYSIS USING Po AND Be NEUTRON SOURCES. J. Tolgyessy, C. P. Popov, G. I. Stefanov, and T. T. Tomov (Slovak Technical Univ., Bratislava and Geological Inst., Sofia). Chem. Zvesti, 18: 48-55(Jan. 1964).

The neutron sources of Po and Be had an activity of 7 curies. The construction of an apparatus and optimum operating conditions for work with the apparatus are de-

scribed. The accuracy of the method is identical to other currently used methods. Its advantage is in the speed, as it takes only 1½ hours to complete. (OTS)

17748 ANALYSIS OF ZIRCONIUM–THORIUM–LANTHANUM–ALUMINUM–CALCIUM–BARIUM–SILICON–BORON OXIDE OPTICAL GLASS. R. Přibel and V. Veselý (Polarographic Inst., Prague). Chemist-Analyst, 53: 43-5(Apr. 1964).

Procedures are described for the determination of Zr, Th, La, Al, Ca, and Ba in glasses containing oxides of the metals with silica and boron oxide. The method is based on successive chelometric titration without separations or the use of masking agents, namely, by appropriate adjustments of the pH of the solution. EDTA and DTPA serve as the titrants. (P.C.H.)

17749 QUANTITATIVE DETERMINATION OF ZIRCONIUM IN ALLOYS AND ORES USING p-IODOAMYGDALIC ACID. Han-hsi Shen. Hua Hsueh Hsueh Pao, 25: 231-5 (1962).

A new gravimetric method for determining Zr using p-iodoamygdalic acid was developed. The method permits the determination of macro and microquantities of Zr in zircon, eudialyte, steel, zirconium bronze, and an alloy based on Cr–Mo–Al with satisfactory results. (OTS)

17750 PHOTOMETRIC DETERMINATION OF ZIRCONIUM WITH XYLENOL ORANGE. Yun-fang Chen and Chang-chi Chu. Hua Hsueh Hsueh Pao, 27: 181-4(1961).

A spectrophotometric method of determining Zr was developed, using xylenol orange. To an aliquot portion (5–10 ml) of the hydrochloric acid solution to be analyzed, containing 25–50 γ Cr, is added a drop of a 0.1% solution of bromocresol green, and the mixture is neutralized with a solution of NH_4OH (1:1) until the green color of the solution changes to blue. Then HCl (1:1) is added until the blue color turns to green, 25 ml HCl (1:2) is introduced, and the mixture is heated to boiling and boiled for 10–15 sec. Then 5 ml of a 0.2% solution of xylenol orange is added, and the solution is again boiled for 10–15 sec. After cooling to room temperature, the solution is diluted with water to 100 ml and determined spectrophotometrically at 560 mμ in a 2-cm cuvette, using the solution of the control experiment as a comparison solution. The presence of large amounts of Al, Cu, Fe, Sn, Ti, and Zn do not interfere with the determination. The method permits the determination of Zr in solution at contents $\geq 2 \cdot 10^{-5}$%. (OTS)

17751 SEPARATION AND DETERMINATION OF SCANDIUM AND THORIUM. I. m-NITROBENZOIC ACID AS A REAGENT. Shu-chuan Liang and Shui-chieh Hung. Hua Hsueh Hsueh Pao, 28: 12-19(1962).

A method was developed for separate gravimetric determinations of Sc and Th in mixtures using m-nitrobenzoic acid (I). First Th is precipitated at pH 1.7. Under these conditions only a negligible amount of Sc precipitates. After reprecipitation, Sc in the precipitate disappears entirely, if the Th:Sc ratio in the mixture to be analyzed is ≥2.2. Sc is precipitated from the filtrate (after removal of Th) at pH 2.8–3.0. A 1-5-fold excess of I (as against that theoretically necessary) is needed for the precipitation of Sc. In the determination of 40–160 mg Th and 6.5–10.0 mg Sc, the error is from −1.4 to +1% for Th and from −2 to +2% for Sc. It was found that within the range 75–450°C the composition of the precipitate of Sc m-nitrobenzoate corresponds to the formula $Sc(C_7H_4O_4N)_3$. It is recommended that the precipitate isolated be dried to obtain the gravimetric form at 120°C. NH_4^+ exerts no noticeable influence, while the presence of the alkali elements produces a small positive error, which is entirely eliminated when Sc m-nitrobenzoate is reprecipitated. Cl^- and NO_3^- do not interfere with the determination of Sc, while CH_3COO^- and SO_4^{2-} lower the result (by 1.5–2% and 5.6–14.5%, respectively). Reprecipitation of the precipitate makes it possible to determine Sc in the presence of 100-fold amounts of the light lanthanides and ≤10-fold amounts of Y. (OTS)

17752 GRAVIMETRIC DETERMINATION OF BERYLLIUM WITH BENZOYLACETONE. Shao-ling Liu and Tien-chen Yin. Hua Hsueh Hsueh Pao, 28: 20-4(1962).

A gravimetric method of determining Be using benzoylacetone (I) as the reagent was developed. Be is precipitated with I from weakly alkaline solutions, containing $(NH_4)_2CO_3$ (pH in the range 8.8–10.5 is optimum) in the form of a precipitate, the composition of which corresponds to the formula $Be(C_{10}H_9O_2)_2$. It was found by the thermogravimetric method that the composition of the precipitate of Be benzoylacetonate does not change upon heating to 140°C, as a result of which its use as the gravimetric form is recommended. The presence of small amounts of PO_4^{3-} and F^- does not interfere with the precipitation of Be. The interfering influence of Cu^{2+}, Ni, Ca, Mg, Mn^{2+} and moderate amounts of Fe^{3+} and Al are eliminated by adding complex former III. Complex former III, 2–3 g of $(NH_4)_2CO_3$, several drops of an ethanol solution of phenolphthalein, and concentrated NH_4OH to a rosy color of the solution are added to 50–100 ml of the solution to be analyzed, containing 0.5–15 mg Be. Then a 3% solution of I in acetone is gradually added until complete precipitation of Be, and an additional 3 ml of the solution of I is introduced. The reaction mixture is heated to 90–100°C and kept at this temperature for 10 min. After cooling, the precipitate formed is filtered off on a crucible with a porous bottom, washed with water, dried at 110–120°C, and weighed. In the determination of not too small amounts of Be (3–15 mg) the error is 0.5%; for smaller amounts it increases to 1%. (OTS)

17753 SEPARATION AND DETERMINATION OF SCANDIUM AND THORIUM. II. QUINALDIC ACID AS A REAGENT. Shu-chuan Liang and Shui-chieh Hung. Hua Hsueh Hsueh Pao, 28: 100-7(1962).

It was established that Sc is quantitatively precipitated by quinaldic acid (I) from solutions with pH 4.8–7.0. Complete precipitation of Sc under these conditions is achieved by introducing a ≥3-fold (with respect to Sc) amount of I. The introduction of large amounts (even 43-fold) does not interfere. The presence of K and Na raises the results by 20–30%. Reprecipitation of Sc entirely eliminates the interfering action of K and Na; Cl^- and NO_3^- exert no appreciable influence, while CH_3COO^- and SO_4^{2-} interfere (the interfering influence of CH_3COO^- is considerably greater than the interfering influence of SO_4^{2-}. Quinaldates of Sc and Th were obtained and investigated thermogravimetrically. It was established that the thermolysis curve of Sc quinaldate also has two plateaus (at 90–150 and 670–1005°C). The thermolysis curve of Th quinaldate also has two plateaus (at 120–150 and 680–960°C). To determine Sc and Th in their mixtures, Th is first precipitated at pH 3.4, the precipitate is removed, washed with a 0.2% solution of I with pH 3.4, dried, and calcined at ~900°C. The filtrate is neutralized with a solution of NH_4OH to pH 7.0 and heated on a water bath for ~1 hr. After cooling, the precipitate of Sc quinaldate formed is filtered off, washed with a 0.2% solution of I with pH 7.0, dried, and calcined at ~90°. In the determination of 20–80 mg Th and 10–35 mg Sc, the error for each of the elements is ≤0.5%. (OTS)

17754 SPECTROPHOTOMETRIC DETERMINATION OF VANADIUM IN URANIUM WITH 8-HYDROXYQUINOLINE (OXINE). S. P. Awasthi and K. A. Khasgiwale (Atomic

Energy Establishment, Trombay, India). Indian J. Chem., 2: 102-4(Mar. 1964).

A simple and rapid procedure is described for the determination of micro amounts of vanadium in uranium. Uranium is removed by extraction with tri-n-butyl phosphate and the interfering elements are extracted as oxinates at pH 9.5. Vanadium oxinate is extracted with chloroform at pH 4.0 and determined spectrophotometrically at 550 mμ. The method, with some modifications, was applied for the determination of vanadium in crude sodium and magnesium diuranates. (auth)

17755 SPECTROCHEMICAL DETERMINATION OF SMALL QUANTITIES OF Zr, Nb, Ta, AND Hf IN ROCKS. V. D. Tsykhanskii and I. A. Krinberg (Inst. of Geochemistry, Irkutsk, USSR). Izv. Sibirsk. Otd. Akad. Nauk SSSR, No. 11, 125-7(1963). (In Russian)

A spectrochemical determination of Zr, Nb, Ta, and Hf in rock using one sample was achieved by preliminary precipitation with benzenearsonic acid. Conditions were found for the simultaneous spectral determination of all four elements in the specimens. (R.V.J.)

17756 THE PERFORMANCE OF A COMMERCIAL HIGH-TEMPERATURE IONIZATION CHAMBER FOR RADIOISOTOPE ANALYSIS OF GAS CHROMATOGRAPHY VAPORS. Kenneth L. Simpson, T. O. M. Nakayama, and C. O. Chichester (Univ. of California, Davis). J. Chromatog., 13: 354-60(Feb. 1964).

A system is described for the simultaneous analysis of the effluent of a gas chromatograph column for thermoconductivity and radioactivity. A gas chromatograph was constructed for inclusion of a 275 ml high temperature ionization chamber. The effluent from the thermoconductivity cell passes directly into the ionization chamber providing coincident peaks on two pen recorder. Argon is used as a purge gas for the system. The sensitivity of the system was such that 400 disintegrations per minute of carbon-14 could be detected. Under ideal conditions 206 dpm could be distinguished from background noise. (auth)

17757 ANALYSIS OF ALKYL ESTERS OF PHOSPHORIC ACID BY GAS CHROMATOGRAPHY. C. J. Hardy (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Chromatog., 13: 372-6(Feb. 1964).

Mono- and di-alkyl phosphoric acids can be converted to volatile methyl esters by treatment with diazomethane in ether. The separation of the mixed methyl alkyl phosphates can readily be achieved by gas chromatography on a 3 ft column of silicone DC200 on a firebrick support at 188°C or silicone E301 on a celite support at 197°C. The method is applicable to the quantitative analysis of mixtures of alkyl esters of phosphoric acid in TBP. (auth)

17758 ELECTROPHORESIS ON CELLULOSE ACETATE PAPER IN STRONG ELECTROLYTES AND CONCENTRATES. EQUIPMENT AND TECHNIQUES; DETERMINATION OF ELECTROPHORETIC MOBILITIES AND SEPARATION OF SOME TRANSURANIC ELEMENTS IN NITRIC MEDIA. F. Clanet, J. Clarence, and M. Verry (Commissariat à l'Energie Atomique, Paris). J. Chromatog., 13: 440-50(Feb. 1964). (In French)

An apparatus for the electrophoresis of ions in strong electrolytes is described. Cellulose acetate membranes were used as the support. The electrophoretic mobilities of U(VI), Pu(IV), Am(III), and Cm(III) were determined in 6 N HNO_3, 10 N HNO_3, and 12 N HNO_3. A separation was obtained. (auth)

17759 ION EXCHANGE PROCEDURES. I. CATION EXCHANGE IN CONCENTRATED HCl AND $HClO_4$ SOLUTIONS. Frederick Nelson, Takeo Murase, and Kurt A. Kraus (Oak Ridge National Lab., Tenn.). J. Chromatog., 13: 503-35(Feb. 1964).

A broad survey of the cation exchange behavior of the elements in HCl and $HClO_4$ solutions is presented and adsorption functions are given. The results are also summarized in the form of two Periodic Tables, which give the distribution coefficients of the elements as a function of M HCl and M $HClO_4$. Many elements are strongly adsorbed from concentrated $HClO_4$ solutions. There are large differences in adsorbability between HCl and $HClO_4$ solutions, particularly at high ionic strength. Application of the data to high ionic strength cation exchange separations is illustrated. (auth)

17760 THE USE OF ELECTRON PROBE MICROANALYZERS WITH GAMMA-ACTIVE MATERIALS. B. M. Jeffery and G. K. Williamson (Central Electricity Generating Board, Berkeley, Eng.). J. Sci. Instr., 41: 172-4 (Mar. 1964).

The changes in sensitivity of the AEI electron probe microanalyzer when used with samples of various γ-activities have been estimated. Three methods for reducing the background count were investigated: use of conventional electronic gates; reduction of the scintillator size to that of the x-ray beam; and lead shielding the scintillator from direct radiation. These methods reduce the background by factors of 5, 10^2, and 10^2, respectively. Nomograms are presented for calculating the sensitivity for any set of conditions. (auth)

17761 PHOTOMETRIC DETERMINATION OF THORIUM AND ZIRCONIUM IN A MIXTURE OF THE TWO. USE OF ARSENAZO. [PART] III. Hiroshi Onishi (Japan Atomic Energy Research Inst., Tokyo). Japan Analyst, 12: 1153-5(Dec. 1963). (In Japanese)

A spectrophotometric method is described for the determination of both Th and Zr with arsenazo III. In 3N hydrochloric acid containing oxalic acid, Th alone forms a colored complex with the reagent. The absorptance is measured at 665 mμ. In 9N hydrochloric acid containing gelatin, both Th and Zr form colored complexes. The absorptance of the 9N hydrochloric acid solution at 665 mμ is equal to the sum of the absorptances of the Th and Zr complexes. Therefore, Zr can be determined by the difference. Satisfactory results were obtained with 5 to 30 μg of Th and 5 to 10 μg of Zr in a volume of 25 ml or with weight ratios of Th/Zr ranging from 0.5 to 6. (from NSA of Japan)

17762 THE ANALYTICAL QUALITY CONTROL SERVICE OF THE DIVISION OF RADIOLOGICAL HEALTH—INTERLABORATORY STUDY OF IODINE-131 SURVEILLANCE MEASUREMENTS IN MILK. Marvin Rosenstein and Abraham S. Goldin. Radiol. Health Data, 5: No. 3, 128-31(Mar. 1964).

The function of the Analytical Quality Control Service of the Division of Radiological Health, Northeastern Radiological Health Laboratory, Winchester, Mass., is reviewed. A summary is included of the fields of investigation. It is concluded that the application of adequately designed samples, properly applied statistical methods, and appropriate corrective measures will result in the quality of radiological measurements being maintained at an acceptable level. Data are presented from an analysis of milk for iodine-131 content. (C.H.)

17763 APPLICATION OF NEUTRON ACTIVATION PAPER CHROMATOGRAPHIC ANALYSIS OF PHOSPHOLIPIDS IN CLINICAL INVESTIGATIONS. R. Blomstrand and F. Nakayama (Univ. of Lund, Sweden). Scand. J. Clin. Lab. Invest., 14: 28-35(1962).

Use of radioactive isotopes in clinical investigation is limited because of the hazard of radiation, but, by labeling the compound after isolation, it is possible to overcome this difficulty in some instances. This can be done by neutron activation. In studying the composition and the metabolism of phospholipids in human beings, it is not always possible to administer enough radioactive ^{32}P; however, after the separation of the phospholipids from human tissue, the P could be activated by neutrons for further analysis. Thus techniques are described for the analysis of phospholipids in human erythrocytes, thrombocytes, bile, intestinal mucosa, brain, and cerebrospinal fluid. Silicic acid-impregnated paper chromatography of phospholipids was done using n-butyl ether, diisobutyl ketone, acetic acid, and water at room temperature. For neutron activation analysis, the paper chromatogram was sealed in an Al container. After irradiation with a slow neutron stream, 5×10^{11} neutrons/cm^2/sec for 15 hr (irradiation was carried out at the Research Reactor AB Atomenergi, Stockholm), autoradiograms were prepared, using a plastic sheet as a filter, and standard x-ray film. After identification, the individual phospholipids were cut from the paper chromatogram, eluted and an aliquot taken for phosphorus determination. It was possible for the first time to analyze phospholipids from samples obtained by liver biopsy, where conventional methods are not suitable since only a few mg of tissue are available. It should also be possible to apply this technique to samples obtained by percutaneous liver biopsy. In this way, changes of the phospholipid composition of human liver in comparison to that of plasma under pathological conditions could be followed. As more reactors become more available, the neutron activation paper chromatographic technique will be used more widely to make a significant contribution in the field of clinical research where only minute samples from patients are available. (BBB)

17764 SPECTROPHOTOMETRIC DETERMINATION OF IRON, NICKEL, CHROMIUM, MOLYBDENUM, URANIUM AND TUNGSTEN WITH THIOGLYCOLIC ACID. Nobuhisa Kono and Toshio Ozawa (Tokyo Metropolitan Industrial Research Inst.). Tokyo Toritsu Kogyo Shoreikan Hokoku, No. 15, 59-62(Sept. 1963). (In Japanese)

Thioglycolic acid was tested as a reagent for spectrophotometric determination of Fe, Ni, Cr, Mo, U, and W, since it forms water-soluble colored complexes with these metals. The optimum pH ranges for the complexes are: Fe^{3+}, 6 to 11 (red); Mo^{2+}, 3 to 5 (yellow); U^{6+}, 9 to 10 (orange); Ni^{2+}, 7 to 8.5 (pink); W^{6+}, 3 to 5 (colorless); and Cr^{6+}, 6 to 9 (green). The relation between absorptance and metal-ion concentration has good linearity. The sensitivities for the ions are, in γ/cm^2: Fe^{3+}, 0.014 (540 mμ); Mo^{2+}, 0.017 (368 mμ); U^{6+}, 0.14 (395 mμ); Ni^{2+}, 0.49 (515 mμ); W^{6+}, 0.034 (306 mμ); and Cr^{6+}, 0.27 (475 mμ). (from NSA of Japan)

17765 SPECTRAL X-RAY DETERMINATION OF Ti CONTENT IN NIOBIUM PENTOXIDE. Yu. G. Lavrent'ev. Zavodsk. Lab., 30: 168-9(1964). (In Russian)

A DRUS^{-2} x-ray spectrometer was used for determining 0.03% Ti in Nb_2O_5. The sensitivity of the method is 0.01%. (tr-auth)

17766 SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN Mo AND ITS COMPOUNDS BY VAPORIZATION METHOD. O. F. Degtyreva and M. F. Ostrovskaya. Zavodsk. Lab., 30: 174-6(1964). (In Russian)

A method was developed for a quantitative spectrographic determination of Cd, Co, As, B, Si, P, Mn, Sb, Fe, Cr, Mg, Sn, Al, Be, Cu, Ni, Ca, Pb, Sr, In, Ba, Zn, Na, and K as impurities in Mo and its compounds. The method involves evaporation enrichment of the impurities and has a determination sensitivity of 3×10^{-7} to 1×10^{-3}% with a root mean square order of error of 10 to 20%. (tr-auth)

17767 EFFECTS OF SOLUTION ON THE RADIATION INTENSITY OF RARE EARTH ELEMENTS IN HYDROGEN–OXYGEN FLAME. O. A. Shiryaeva and Sh. G. Melamed (State Research and Design Inst. of Rare Earth Industry, Academy of Sciences, USSR). Zavodsk. Lab., 30: 183-5 (1964). (In Russian)

The highest radiation intensity point was found with rare earth specimens treated with perchloric acid and dissolved in ethyl alcohol. The spectra obtained for Eu, La, and Y are included. (tr-auth)

17768 PHOTONEUTRON METHOD FOR DETERMINING BERYLLIUM IN LARGE SPECIMENS. E. I. Zaitsev and V. N. Smirnov. Zavodsk. Lab., 30: 190-3(1964). (In Russian)

A scintillation neutron recording method using the (γ,n) reaction in beryllium oxide was suggested for determining Be in large samples. The gamma source was ^{124}Sb. For an exposure time of 10 min and a 10-mC source, the sensitivity threshold was 0.002% BeO. (tr-auth)

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Refer also to abstract 19080.

17769 (ANL-6725(p.99-111)) CHEMISTRY OF LIQUID METALS. I. Johnson and H. M. Feder (Argonne National Lab., Ill.).

The solubility of plutonium in liquid zinc may be represented by the empirical equation: (458 to 752°C) log (at. % plutonium) = $8.612 - 10090T^{-1} + 1.461 \times 10^6T^{-2}$. Two activation methods for the determination of oxygen in sodium are being investigated. The first involves irradiation by fast (14.5-Mev) neutrons to produce ^{16}N activity by the reaction $^1_0n + {}^{16}_8O \rightarrow {}^{16}_7N + {}^1_1H$. The second method involves triton irradiation to produce ^{18}F activity by the reaction $^3_1T + {}^{18}_8O \rightarrow {}^{18}_9F + {}^1_0n$. The tritons are produced in situ by thermal neutron irradiation of lithium (added to the sodium sample) by the reaction $^1_0n + {}^6_3Li \rightarrow {}^3_1T + {}^4_2H$. The solubility of carbon in liquid sodium is being measured as a function of temperature and oxygen content as a first step in a basic study of the transport of carbon by liquid sodium. The thermodynamics of the plutonium–zinc and plutonium–cadmium alloys are being studied by means of a high-temperature galvanic cell method. The activity coefficient of saturated solutions of plutonium in liquid zinc may be represented by the equation $\log \gamma_{Pu} = 5.312 - 9713T^{-1}$. The activity coefficient of saturated solutions of plutonium in liquid cadmium may be represented by the equation $\log \gamma_{Pu} = 4.786 - 6473T^{-1}$. An optical absorption method is being developed to study the thermodynamics of binary solutions of the alkali metals. Rare earth metal–cadmium systems are being studied by the effusion method. The following sequences of intermediate phases are found in binary systems of cadmium with lanthanum, cerium, praseodymium, and neodymium: lanthanum–cadmium system: $LaCd_{11}$, La_2Cd_{17}, La_3Cd_{13}, $LaCd_2$, and LaCd; cerium–cadmium, praseodymium–cadmium, and neodymium–cadmium system: MCd_{11}, MCd_6, M_3Cd_{13}, M_4Cd_{13}, MCd_2, and MCd. (auth)

17770 (ANL-6725(p.191-200)) CALORIMETRY. W. N. Hubbard and H. M. Feder (Argonne National Lab., Ill.).

Refinements in calculations led to slight revisions in the derived thermal data for the formation of uranium hexafluoride from the elements at 25°C. The revised data are: standard energy of formation, ΔEf^0_{298}, -520.7_9(c), -509.5_1(g); standard enthalpy of formation ΔHf^0_{298}, -522.5_7(c), -510.7_0(g); and Gibbs energy of formation, ΔGf^0_{298}, -491.8_9(c), -490.7_2(g). The uncertainty intervals are $\pm 0.4_4$ for uranium in the crystalline state and $\pm 0.4_6$ in the gaseous state. Preliminary investigations are in progress to develop satisfactory techniques for the determination of the heat of formation of uranium monosulfide. It was found that, with proper protection of the sample from fluorine before ignition, the fluorine bomb calorimetric method will very likely be suitable. Preliminary investigations are in progress to develop satisfactory techniques for the determination of the heats of formation of tetrafluoromethane (CF_4) and silicon carbide. Satisfactory techniques were found, and the calorimetric system is being calibrated preparatory to the calorimetric studies. A critique of the available literature data for the heats of formation of hydrogen fluoride gas and its aqueous solutions is being made. The furnace component of the 1500°C enthalpy calorimeter was disassembled. It was found that the three silver heat shields and three of the five aluminum heat shields had melted to a considerable extent. Modifications and simplifications were made to the furnace core, and the furnace was reassembled. Experiments were performed to obtain heat transfer data across the ¾-in. dust shield containing bubbled aluminum oxide. (auth)

17771 (DP-842) FLUORIDE COMPLEXING OF U(VI) AND Pu(IV) IN SOLUTIONS CONTAINING Al(III) AND Zr(IV). Carl S. Schlea and John T. Lowe (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Jan. 1964. Contract AT(07-2)-1. 18p.

The relative amounts of fluoride complexing by Al(III), Zr(IV), Pu(IV), and U(VI) in solutions containing fluoride and mixtures of these cations was measured. The results can be used to estimate the optimum composition of solution for solvent extraction of U(VI) and Pu(IV). (auth)

17772 (HW-78724) HIGH-TEMPERATURE THERMODYNAMIC PROPERTIES OF HELIUM. D. R. Doman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1963. Contract AT(45-1)-1350. 16p.

An updated compilation of the thermodynamic properties of He reported in the literature is given. The temperature and pressure variations of specific heat, specific heat ratio, thermal conductivity, viscosity, Prandtl number, density, and enthalpy are presented graphically. (D.C.W.)

17773 (KR-67) THE PARTIAL FREE ENTHALPY, ENTHALPY AND ENTROPY OF OXYGEN IN THE UO_{2+x} PHASE AT HIGHER TEMPERATURE. Kjell Hagemark (Norges Tekniske Høgskole, Trondheim. Institutt for Silikatforskning). Feb. 1964. 25p. (CONF-457-1)

From International Atomic Energy Agency Panel Meeting, Vienna, Mar. 1964.

Equilibrium measurements carried out in the UO_{2+x} phase are reviewed. Values for the partial free enthalpy, enthalpy, and entropy are evaluated. At temperatures above 1100°C and in the composition range $0.05 < x < 0.20$ (x is the non-stoichiometry in UO_{2+x}), the empirical expression for the partial molar entropy of oxygen, $\overline{S}_{O_2} - S^0_{O_2}$, is: $-6.5 - 115 \cdot x$ (in e.u.), and for the partial molar enthalpy, $\overline{H}_{O_2} - H^0_{O_2}$: $-6.2 - 54 \cdot x$ (in kcal). A short discussion of the precision of the data is given. (auth)

17774 (LADC-6082) THE PREPARATION AND THERMAL DECOMPOSITION OF THE CARBONATES OF Tb, Dy, Ho, Er, Tm, Yb, Lu, Y, AND Sc. Earl L. Head and Charles E. Holley, Jr. (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 18p. (CONF-405-3)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

Results are presented of the extension of the carbonate studies to the heavier lanthanons, and yttrium and scandium. The hydrated carbonates were prepared by precipitation from a homogeneous aqueous solution by thermal decomposition of the corresponding trichloroacetates as previously described. In all cases except for scandium and lutetium, the ratio of carbonate to oxide was 2.93 or greater, the ratio of water to oxide was between 2.1 and 2.3, and the compounds were isostructural with $Nd_2(CO_3)_3 \cdot 2H_2O$. For lutetium, the compound and corresponding ratios of 2.99 and 5.2 and the structure was different from the others. For scandium, the compound with the highest carbonate content had a ratio of carbonate to oxide of 2.25. The thermal decomposition studies were done on the dicarbonate, $Sc_2O(CO_3)_2 \cdot 4H_2O$. The thermal decomposition of these compounds was studied with a recording vacuum thermobalance in vacuum, carbon dioxide, and water vapor. Except for lutetium and scandium, the decomposition proceeded by the steps $M_2(CO_3)_3 \cdot xH_2O \rightarrow M_2(CO_3)_3 \rightarrow$ intermediate $\rightarrow M_2O_3$ as shown by corresponding plateaus in the pyrolysis curves. The intermediate was the dioxymonocarbonate for terbium and dysprosium. For Ho through Yb and for Y the intermediate contained less carbonate than the dioxymonocarbonate. No intermediate carbonate was detected for lutetium. The plateau for the intermediate was shorter for the higher atomic number elements. The temperature of decomposition of the normal carbonates under 500 mm pressure of carbon dioxide was about 500°C with no marked trend with atomic number. For the intermediate there was a definite trend toward lower decomposition temperatures at higher atomic numbers except for ytterbium, which was out of place. Yttrium carbonate was similar to holmium and erbium carbonates in its behavior. (auth)

17775 (NP-13766(p.85-93)) CALCULATIONS FOR DISTILLATION OF DEGRADED HEAVY WATER. P. Svendsas (Spain. Junta de Energia Nuclear, Madrid and European Atomic Energy Society, Paris).

The D_2O concentration in the heavy water moderator of the JEEP reactor at Kjeller has decreased from 99.8 to 99.4 mol %. The number of plates required for a distillation column to reconcentrate it to 99.8% was calculated as a function of distillate compositions, molar flow rates, and reflux ratios (reflux flow rate/distillate flow rate). Estimates of the column properties and distillation rate were obtained. (D.C.W.)

17776 (NP-13766(p.95-118)) QUELQUES ASPECTS CHIMIQUES DE L'UTILISATION DE L'EAU LOURDE DANS LES REACTEURS NUCLEAIRES. (Some Chemical Aspects of the Use of Heavy Water in Nuclear Reactors). G. Dirian, P. Vignet, and L. Dolle (Spain. Junta de Energia Nuclear, Madrid and European Atomic Energy Society, Paris).

The chemical pollution and radiochemical decomposition of heavy water are discussed on the basis of CEA experience with heavy water piles. The origins, nature, and effects of contaminants are reviewed, together with purification techniques. The use of ion exchange techniques to control poisons receives particular attention. The effects of various factors on decomposition are dis-

cussed, and a system for catalytic recombination is described. (D.C.W.)

17777 (NP-13766(p.119-33)) REVERSIBLE DEUTERIZATION AND RADIATION-INDUCED FORMATION OF LIGHT WATER IN ION EXCHANGE RESINS. P. Baertschi and R. Haberli (Spain. Junta de Energia Nuclear, Madrid and European Atomic Energy Society, Paris).

Reactor heavy water is diluted in the deuterization and dedeuterization of ion exchange resins used for purification and by light water production from irradiation in reactor operation. The optimum resin particle size and flow rate for resin columns were determined, and the production of gases and H_2O in gamma irradiation of some resins in heavy water was studied. (D.C.W.)

17778 (NYO-10707) AN INVESTIGATION OF COMPLEX IONS IN FUSED SALT MEDIA. Final Report. Ronald A. Bailey and Robert Baboian (Rensselaer Polytechnic Inst., Troy, N. Y.). Jan. 1964. Contract AT (30-1)-2787. 73p.

The methods of potentiometry and polarography have been applied to study the behavior of the group IVB transition metals titanium, zirconium, and hafnium in the LiCl–KCl eutectic melt. This behavior was found to depend strongly on the purity of the melt. Some observations of the effect of impurities in the melt were observed. Solubilities of the metals and their oxides was also investigated. Solutions of Ti(II) in the temperature range 450°C to 550°C were prepared by the anodic dissolution of Ti metal. A procedure for the coulometric titration of Ti(II) was developed which produced solutions of Ti(III). Standard potentials were obtained for the related electrode systems and polarograms of the solutions were recorded. Anodic dissolution of Zr metal yielded Zr(IV) at 450°C and primarily Zr(II) at 550°C. Zr(III) was not observed. Standard potentials were obtained for the stable electrode systems and the polarographic behavior of Zr(IV) and Zr(II) in the melt was investigated. Anodic dissolution of Hf metal in the temperature range 450°C to 550°C produced solutions of Hf(IV). Polarograms of these solutions were recorded and the standard potentials of the Hf(IV)–Hf(O) electrode system were obtained. The potentiometric and polarographic behavior of these systems along with thermodynamic calculations established the positions of the electrode systems in an electromotive force series, was valuable in studying the course of chemical reactions and electrode processes in the melt, and produced information involving complex formation and interactions between the various species in the melt. (auth)

17779 (SC-4972(RR)) THE OXIDATION OF U(IV) BY Tl(III) OVER AN EXTENDED CONCENTRATION RANGE IN AQUEOUS-PERCHLORIC ACID SOLUTIONS. James O. Wear (Sandia Corp., Albuquerque, N. Mex.). Jan. 1964. Contract AT(29-1)-789. 30p.

The kinetics of the oxidation of U(IV) by Tl(III) were examined in aqueous-perchloric acid solution with the concentrations of U(IV) and Tl(III) varied over a 2000-fold range. The orders with respect to U(IV) and Tl(III) were found to be different in different concentration ranges. The data were explained using combinations of four paths involving hydrolytic species. The temperature was varied from 15 to 50°C and the activation energy was found for each rate constant. (auth)

17780 (SC-RR-64-67) THERMODYNAMIC PROPERTIES OF THE METAL BROMIDES, IODIDES, SULFIDES, SULFATES, CHROMATES, METAPHOSPHATES, ORTHOPHOSPHATES, MOLYBDATES, TUNGSTATES, BORATES AND HYDROXIDES. Final Report. W. J. Cooper and D. A. Scarpiello (Callery Chemical Co., Penna.). Jan. 1964. For Sandia Corp., Albuquerque, N. Mex. Contract [AT (29-1)-789]. 56p.

The thermodynamic properties of the metal bromides, iodides, sulfides, sulfates, chromates, metaphosphates, orthophosphates, molybdates, tungstates, borates, and hydroxides found in the literature through December 1963 have been tabulated. The free energies of formation of these compounds have also been plotted as a function of temperature. (auth)

17781 (AEC-tr-6388) SCREENING OF METAL-METAL BONDS IN EQUIATOMIC OXIDES AND CARBIDES OF TRANSITION METALS WITH THE NaCl STRUCTURE. V. A. Takhai and P. V. Gel'd. Translated by Helen J. Chick and N. H. Krikorian (Los Alamos Scientific Lab., N. Mex.), from Fiz. Metal. i Metalloved., 16: 493-4(1963). 5p.

Screening of metal-metal bonds in Ta, V, and Nb oxides and carbides with the NaCl structure is discussed. The results of the calculations of the integrals of the overlapping $S(nd_\epsilon, nd_\epsilon)$ for the carbides and oxides of Ti, V, and Nb, together with data on the deficiency of the oxygen sublattices (d_0, %), as well as the electric conductivity (ρ μohm · cm), the mobility of the carriers of the current (μ, cm^2 sec), and the energy of atomization (ΔH_A kcal/mole) are tabulated. The data show that a consistent relationship exists between the value of $S(d_\epsilon, d_\epsilon)$ and the deficiency of the oxygen sublattice, which is found in the direct dependence on the screening effect of the Me-Me bonds. (P.C.H.)

17782 (CEA-tr-R-1746) ETUDE DE LA CINÉTIQUE DE L'ÉCHANGE ISOTOPIQUE ENTRE L'OXYGÈNE, GAZEUX ET L'OXYGÈNE ABSORBÉ PAR DES COMPOSÉS COMPLEXES ORGANIQUES DU COBALT. (Study of the Kinetics of the Isotopic Exchange Between Gaseous Oxygen and Oxygen Absorbed by Organic Complexes of Cobalt). G. M. Pantchenkov and A. M. Tolmatchov. Translated into French from Kinetika i Kataliz, 3: 861-4(1962). 9p.

Isotopic exchange between gaseous oxygen ($^{16}O^{18}O$) and oxygen $^{16}O_2$ absorbed by bis(N,N'-disalicylaldehydethylenediamine)-μ-aquodicobalt (Co_2X_2) and bis[N,N'-di (3 nitrosalicylaldehyde)ethylenediamine]-μ-aquodicobalt ($3\text{-}NO_2Co_2X_2$) was studied mass spectrometrically in a static system. The shape of the kinetic curves indicates that the exchange proceeds by two mechanisms of different rates. A reaction mechanism is proposed. Separation of oxygen isotopes by these reactions may be possible. (D.C.W.)

17783 (NP-tr-1120) SEALING AND WELDING OF CARBON MATERIALS BY MEANS OF HYDROCARBON CRACKING. R. Blanchard, C. Moreau, and J. Philippot. Translated by J. A. Roberts (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.), from report presented at "19th International Congress of Pure and Applied Chemistry, London, July 10-17, 1963." (CEA/CENG/PCBT-63/64 and MET 63/22). 20p.

The precise conditions for obtaining a deposit of pyrocarbon in a matrix of porous carbon were studied. The pyrocarbon was prepared at moderate temperature, starting from natural gas. Two applications were considered. The rendering impermeable (sealing) of artificial graphite: in this field the results were very interesting, since it is possible to diminish the permeability coefficient K by a factor of 10^6 using an extremely simple treatment. The samples thus rendered impermeable showed considerable resistance to thermal shock. The joining (welding) of pieces of carbon material: the same process can be used to obtain tight joints by means of a deposit of pyrocarbon. The

joints are very firm and resistant to thermal shock. This process admits, in particular, the manufacture of tight containers in graphite. (auth)

17784 RARE EARTH CHELATES DERIVED FROM 8-QUINOLINOL. Robert G. Charles and Antoinette Perrotto (Westinghouse Research Labs., Pittsburgh). Anal. Chim. Acta, 30: 131-8(Feb. 1964).

The composition and heat stabilities of trivalent lanthanide oxinates prepared by homogeneous precipitation (urea hydrolysis in the presence of acetic acid) were studied. The products contain acetate ion; and the molar ratio oxinate/metal is less than three. Polymeric structures are proposed for these materials. Heat stability in an inert atmosphere, as determined by thermogravimetric, thermomanometric, and differential thermal analyses, decreases with increasing atomic weight of the metal. (auth)

17785 ANION-EXCHANGE PAPER CHROMATOGRAPHY OF METAL IONS. Joseph Sherma and Charles W. Cline (Lafayette Coll., Easton, Penna.). Anal. Chim. Acta, 30: 139-47(Feb. 1964).

The migration of 26 ions on anion-exchange paper was studied with five different complexing solvents. The results are reported as a function of the sign of the charge on each ion determined electrochromatographically. Several possible separations are presented, but it is shown that the prediction of separations, knowing only the charge on several substances, is impossible. It is also demonstrated that ion-exchange column experiments and ion-exchange paper experiments do not necessarily yield identical results. (auth)

17786 A SIMPLE METHOD FOR THE DISSOLUTION OF PLATINUM METALS. David R. Gabbe and David N. Hume (Massachusetts Inst. of Tech., Cambridge). Anal. Chim. Acta, 30: 308-9(Mar. 1964). (TID-19344)

A method is described for the dissolution of platinum metals using potassium pyrosulfate containing potassium chloride. The oxidizing strength of fused potassium pyrosulfate increases with increasing temperature, and at 600°C chloride ion appears to be oxidized slowly to chlorine. When the platinum metals are fused with a mixture of potassium chloride and pyrosulfate, they dissolve rapidly. Presumably the chlorine formed acts on the metals directly and the presence of chloride ion removes and stabilizes the products as chloride complexes. Advantages of the method are given. (P.C.H.)

17787 FLUORINATION OF XENON. R. Hoppe, W. Daehne, H. Mattauch, and K. Roedder (Universität, Münster, Ger.). Angew. Chem. Intern. Ed. Engl., 1: 599 (Nov. 1962).

Xenon fluoride was prepared by mixing commercial Xe with carefully purified fluorine (prepared electrolytically) in a $Xe:F_2$ proportion of 1:2 by volume in a sealed quartz vessel and subjected at room temperature to discharges from an induction coil. The XeF_2 initially formed was plainly unstable and disproportionated into Xe and a compound containing more fluorine, probably XeF_4. (P.C.H.)

17788 MEAN AMPLITUDES OF VIBRATION AND RELATED QUANTITIES FOR TETRAHEDRAL XY_4 MOLECULES. S. J. Cyvin, J. Brunvoll, B. N. Cyvin, and E. Meisingseth (Norges Tekniske Högskole, Trondheim, Norway). Bull. Soc. Chim. Belges, 73: 5-22(Jan.-Feb. 1964).

Spectroscopic calculations for 38 tetrahedral XY_4 molecules were performed, assuming small harmonic vibrations. The results of following quantities are reported: force constants, compliance constants, mean-square amplitude matrices, parallel and perpendicular mean-square amplitudes, mean amplitudes of vibration, and Bastiansen-Morino's shrinkage effects. One arithmetic error in previous work on this molecular model is corrected. (auth)

17789 NEW URANATES AND HYPOURANATE OF THALLIUM. Jacques Prigent and Bernard Grislain (Faculté des Sciences, Rennes, France). Compt. Rend., 258: 1814-16(Feb. 10, 1964). (In French)

The uranates of monovalent thallium were isolated by dry methods. The thermogravimetric study of the reactions defined the formation mechanism of these uranates. The uranates formed were the monouranate Tl_2UO_4, diuranate $Tl_2U_2O_7$, and triuranate $Tl_2U_3O_{10}$. Reduction of the diuranate leads to a new compound of pentavalent uranium, hypouranate $TlUO_3$. (tr-auth)

17790 THE PREPARATION OF THE HETERONIOBATES OF A NUMBER OF TRANSITION METALS. A. V. Lapitskii, L. G. Vlasov, and V. I. Bezrukov (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 154: 868-70(Feb. 1, 1964). (In Russian)

On reacting potassium metaniobate with Cu(II), Pb(II), Cr(III), Mn(II), Fe(II), Co, Ni, and Ce(III), it was found that a precipitate forms at the equivalence point that is soluble in excess $KNbO_3$. The equivalence point occurs at a ratio of Me:Nb equal to 1:2 for divalent metals, and 1 to 3 for trivalent metals. The reaction is given by the following general equation: $nNbO_3^- + Me^{n+} \rightarrow Me(NbO_3)_n$. Dissolution of the initial precipitate in excess $KNbO_3$ takes place according to the following equation: $mNbO_3^- + Me(NbO_3)_n \rightarrow [Me(NbO_3)_{n+m}]^{(n+m^{-1})-}$. The optical spectra of the aqueous solutions show that a new type of compound is formed. The presence of a negative complex is indicated by the fact that cerium complex tagged with ^{144}Ce moves towards the anode. Analysis shows that the cerium compound has the following formula: $K_3[Ce(NbO_3)_2(OH)_4] \cdot 5H_2O$. The general formula is $K_n[Me(NbO_3)_m(OH)_p] \cdot \chi H_2O$, where Me = Fe^{2+}, Co^{2+}, Ni^{2+}, Cu^{2+}, and Ce^{3+}. These compounds have not been previously reported in the literature. (TTT)

17791 MEAN AMPLITUDES OF VIBRATION AND THERMODYNAMIC FUNCTIONS OF SOME METAL HEXAHALIDES. G. Nagarajan (Oklahoma State Univ., Stillwater). Indian J. Pure Appl. Phys., 2: 86-90(Mar. 1964).

Force constants were evaluated for ruthenium hexafluoride, rhodium hexafluoride, tungsten hexachloride and tungsten hexabromide, making use of the Wilson's group theoretical method and the redundancy conditions. The mean amplitudes of vibration for these molecules were computed for the temperatures T = 0 and 298°K. The inactive frequency under the F_{2u} symmetry species for ruthenium hexafluoride was estimated to be 188 cm^{-1} from the force constants. The Ru−F and Rh−F interbond distances were also estimated employing these force constants and Badger's empirical relation. The molar thermodynamic functions for the ruthenium hexafluoride and rhodium hexafluoride molecules were calculated with the assumption of a rigid rotator, harmonic oscillator model for the temperature range 50 to 2000°K. (auth)

17792 RADIOCHLORINE EXCHANGE REACTIONS IN SULFUR MONOCHLORIDE. Ronald R. Wiggle and T. H. Norris (Oregon State Univ., Corvallis). Inorg. Chem., 3: 539-41(Apr. 1964).

Chloride lability in the solvent sulfur monochloride was investigated by studying radiochlorine exchange rates between the solvent and the four solutes tetraethylammonium

chloride, antimony tri- and pentachlorides, and thionyl chloride. Exchange is rapid and complete in the first three cases and, at best, very slow in the last. The results suggest a ready dissociation of solvent chloride in the presence of (and only in the presence of) a strong chloride acceptor, none being evident with thionyl chloride. It is inferred that the ready exchange observed with the ionic substance, tetraethylammonium chloride, probably goes via a bimolecular process or an association equilibrium. The experiments appear to imply a limited general importance for chloride dissociation in this medium. (auth)

17793 KINETICS OF THE EXCHANGE OF WATER BETWEEN OXYGEN-18-LABELED SOLVENT AND AQUORHODIUM(III) CATION. W. Plumb and G. M. Harris (State Univ. of New York, Buffalo). Inorg. Chem., 3: 542-5 (Apr. 1964).

A kinetic study was made of the exchange reaction between Rh^{3+}_{aq} ion and ^{18}O-labeled solvent water, using a conventional isotopic dilution technique. Data were obtained on the dependence of the exchange on complex ion concentration, acidity, temperature, and ionic strength. The hydration number was also evaluated, and is 5.9 ± 0.4. The exchange reaction obeys a rate law of the form $R = k_1[Rh \times (H_2O)_6^{+3}] + k_2K_a[Rh(H_2O)_6^{+3}]/[H^+]$ where k_1 and k_2 first-order rate constants for the dissociation of a water molecule from the hexaaquo and pentaaquohydroxo ions, respectively, and K_a is the first acid dissociation constant of hexaaquorhodium(III) cation. At 64.4°C and $\mu = 12$, the magnitudes of the three constants are 1.3×10^{-3}, 2×10^{-1}, and 4×10^{-3} M, respectively. The Arrhenius activation energy for the acid-independent process is 33 ± 3 kcal/mole. (auth)

17794 SOLUBILITY DIAGRAM FOR TERNARY SYSTEM $Nd(NO_3)_3 - HNO_3 - H_2O$ AT 25°. K. E. Mironov and E. D. Sinitsyna (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sibirsk. Otd. Akad. Nauk SSSR, No. 11, 3-7 (1963). (In Russian)

A complete phase diagram of the ternary system $Nd(NO_3)_3 - HNO_3 - H_2O$ at 25°C showed that nitric acid acts as a dehydrating agent on neodymium nitrate hydrates. The concentrations of nitric acid in equilibrium with the $Nd(NO_3)_3 \cdot 6H_2O$, $Nd(NO_3)_3 \cdot 4H_2O$, $Nd(NO_3)_3 \cdot H_2O$, and $Nd(NO_3)_3$ phases, or its complex, with HNO_3 were found. (R.V.J.)

17795 CRYSTALLOCHEMICAL STUDIES OF THORIUM TETRAFLUORIDE HYDRATES. Yu. V. Gagarinskii, E. D. Ruchkin, L. A. Luk'yanova, G. N. Kustova, and S. S. Batsanov. Izv. Sibirsk. Otd. Akad. Nauk SSSR, No. 11, 8-16 (1963). (In Russian)

Thorium tetrafluoride hydrate crystals, prepared by precipitation from thorium salts by hydrofluoric acid, were studied by x-ray, thermographic, refractometric, and spectrometric methods. It was shown that the water in the thorium tetrafluoride crystal hydrate structure is bound to fluorine atoms by hydrogen bonding. (R.V.J.)

17796 MELTING DIAGRAM OF $ScCl_3 - NaCl$ SYSTEM. N. Ya. Fedorov, S. I. Sklyarenko, and E. S. Petrov (Inst. of Chemistry and Metallurgy, Novosibirsk, USSR). Izv. Sibirsk. Otd. Akad. Nauk SSSR, No. 11, 120-2(1963). (In Russian)

Phase studies of the system $ScCl_3 - NaCl$, with $ScCl_3$ concentration from 0 to 95%, indicated a compound Na_3ScCl_6 melting incongruently at 566°C. There is a eutectic at 38 mole % $ScCl_3$ at 480°C. (R.V.J.)

17797 THE EFFECTS OF THERMAL AND RF-ACTIVATED OXIDATION ON THE AIR REACTIVITY OF GRAPHITE. A. R. Blake, C. A. Hempstead, and P. P. Jennings (Central Electricity Generating Board, Gloucestershire, Eng.). J. Appl. Chem. (London), 14: 115-17(Mar. 1964).

The increase in the chemical reactivity of nuclear graphite towards air following thermal and r-f activated oxidation was compared and evidence obtained for an enhanced reactivity following the activated oxidation, without change in surface area. The dependence of reactivity on surface area was also studied for virgin and thermally oxidized samples and a linear relation found between the two quantities. (auth)

17798 EXPERIMENTAL DETERMINATION OF THE THERMAL CONDUCTIVITY OF MOLTEN LITHIUM FROM 320° TO 830°C. J. W. Cooke (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 40: 1902-9(Apr. 1, 1964).

A comparative, axial-heat-flow apparatus with compensating guard heating was developed to determine the thermal conductivity of 99.8 + wt % molten lithium. Contrary to the data for two other alkali metals (sodium and potassium), the conductivity of lithium was found to increase linearly from 0.445 W/cm/°C at 320°C to 0.606 at 830°C. The total uncertainty in the results was conservatively estimated to vary from ±8 to ±15% from the lower to the higher temperatures. Unpublished data from 282 to 521°C by the Naval Research Laboratory average 4% below the present results. The values predicted by two correlations — the equation of Ewing et al. and the Wiedemann–Franz relationship — are uniformly 10 and 6% higher, respectively, than the present data. (auth)

17799 RELATIONS OF ISOMORPHISM IN THORIUM AND URANIUM OXALATE HYDRATES. Rene Bressat, Bernard Claudel, and Yves Trambouze (Institut de Recherches sur la Catalyse, Rhone, Switzerland). J. Chim. Phys., 60: 1265-9(Nov.-Dec. 1963). (In French)

The crystalline structures of $Th(C_2O_4)_2 \cdot 6H_2O$, $Th(C_2O_4)_2 \cdot 2H_2O$, $Th(C_2O_4)_2 \cdot H_2O$, $Th(C_2O_4)_2$, $U(C_2O_4)_2 \cdot 6H_2O$, $U(C_2O_4)_2 \cdot 2H_2O$, and $U(C_2O_4)_2 \cdot H_2O$ were determined by the Debye-Scherrer method of x-ray diffraction by powders. The angles, intensities, and structure parameters are tabulated. The oxalates are isomorphs. The hexahydrates have triclinic structure, while the others have orthorhombic. (D.C.W.)

17800 CATHODIC ACTION OF THE METAL COMPLEXES AT THE DROPPING MERCURY ELECTRODE. XI. URANYL-ANTIPYRINE COMPLEX. Tsai-teh Lai and Han-ton Lin (Cheng Kung Univ., Tainan, Taiwan). J. Chinese Chem. Soc. (Taiwan), 10: 71-9(Sept. 1963).

Polarographic measurements were made on U (uranyl ion) in antipyrine solutions. A reversible and diffusion-controlled wave was obtained over the range 1.5 to 4.7 and antipyrine concentration ranging from 0.016 to 0.631 M. At pH's between 2.3 and 4.7, the half-wave potential was independent of pH value. At pH lower than 2.3, one hydrogen ion was involved in the reduction. The U(VI)-antipyrine complex was found to be a chelate species of $UO_2A_2^{2+}$ and $UO_2A_3^{2+}$ in antipyrine concentrations lower than 0.155 M and at pH 3.5, but was a simple complex species of $UO_2A_6^{2+}$ in antipyrine of concentration higher than 0.155 M. The value of i_d/C (where i_d is the diffusion current and C the concentration of uranyl ion) is constant at 2.7 and 3.2 for pH values 2.0 and 3.5, respectively, over a 4.4×10^{-4} M to 5.5×10^{-3} M range of U concentration. It was found that uranyl ion formed a yellowish glassy precipitate with antipyrine in the presence of perchlorate ion. Therefore, perchlorate must be avoided in studying the uranyl–antipyrine system. Since the polarographic wave was not affected by nitrate ion, uranyl nitrate dissolved in solutions of potassium ni-

trate in water was used. The detergent Triton X-100 was added to the solutions to depress the maximum of the polarographic wave. (BBB)

17801 PORES IN TANTALUM OXIDE FILMS AND THEIR INFLUENCE ON THE PHOTORESPONSE. R. Dreiner and J. Schimmel (Sprague Electric Co., North Adams, Mass.). J. Electrochem. Soc., 111: 453-6(Apr. 1964).

Experimental evidence is presented that indicates that HF attacks preferentially along cracks, pores, or other singularities that exist in anodic tantalum oxide films. The defects when enlarged by the HF etch permit an electrochemical emf to arise. The effects of the electrochemical emf on the photoresponse of tantalum oxide are discussed. (auth)

17802 CATION-EXCHANGE BETWEEN MOLTEN SALTS AND A SPECIAL PORCELAIN OF HIGH SODIUM CONTENT. R. J. Labrie (National Bureau of Standards, Washington, D. C.). J. Electrochem. Soc., 111: 473-6 (Apr. 1964).

The ability of a special porcelain of high sodium content, 7.16% by weight, to rapidly undergo cation-exchange when immersed in certain molten salts was studied. In melts of potassium, rubidium, or silver salts, exchange was complete and reversible; in melts of lithium, cuprous copper, and cesium salts, partial exchange or reaction took place. It was found possible to obtain mechanically sound pieces of porcelain that could serve as ion-conductive membranes after exchange by potassium, lithium, and silver. The porcelain did not have a strong enough retention for potassium, rubidium, or silver ions to separate them effectively from sodium ions in the molten mixtures that were studied. (auth)

17803 KINETICS OF THE DECOMPOSITION OF Ce(IV) CHLORIDE COMPLEX IN NITRIC ACID MEDIUM AND THE ABSORPTION SPECTRA OF THE COMPLEX. Kalyan K. Sengupta, P. K. Pal, and S. P. Moulik (University Colleges of Science and Tech., Calcutta). J. Indian Chem. Soc., 40: 989-92(Dec. 1963).

The decomposition kinetics of Ce(IV) chloride complex in nitric acid medium was studied. The decomposition rate was found to be of first order with respect to the colored complex. The apparent activation energy and entropy of activation were found to be 14.8 kcal/mole and −12.3 eu, respectively. The absorption spectra of the complex were also studied. (auth)

17804 THERMAL STUDIES ON NIOBIUM COMPOUNDS. I. NIOBIC ACID AND SOME NIOBIC ACID AMINE DERIVATIVES. M. A. Hughes (Bradford Inst. of Tech., Eng.). J. Less-Common Metals, 6: 232-8(Mar. 1964).

Niobic acid and the products derived from solutions of niobic acid in aliphatic amines were subjected to thermal gravimetric and differential thermal analysis. The evidence from these studies, together with some infra-red work, suggests that an olation process must occur in the aging of niobic acid and supports structures that have been suggested for the product derived from niobic acid and primary amines. (auth)

17805 REPORT ON THE CHEMISTRY OF NIOBIUM AND TANTALUM ELEMENTS. XXXII. THE REACTION OF TANTALUM WITH QUARTZ GLASS $14Ta + 5SiO_2 = 5Ta_2Si + Ta_2O_5$. H. Schaefer, E. Schibilla, R. Gerken, and H. Scholz (Universität, Münster, Ger.). J. Less-Common Metals, 6: 239-43(Mar. 1964). (In German)

Tantalum and silica glass react at 800–1100°C according to the above-mentioned equation if the reaction vessel contains gaseous substances ($TaCl_5$, TaI_5), causing chemical transport of SiO_2 to Ta. The observations are understandable from the point of view of kinetics and thermodynamics. (auth)

17806 SIGNIFICANCE OF PHYSICAL STATE OF STARTING PRECIPITATE IN GROWTH OF URANIUM DIOXIDE PARTICLES. H. Doi and T. Ito (Mitsubishi Metal Mining and Metallurgical Lab., Omiya City, Japan) J. Nucl. Mater., 11: 94-106(Jan. 1964).

The effects of physical state of starting ammonium diuranate (ADU) precipitate upon growth of resulting UO_2 particles in heat treatment have been studied by means of optical and electron-optical microscopy and particle size analysis. It was found that ADU precipitate usually consists of agglomerated particles, and that main feature of the agglomeration essentially persists throughout calcination to UO_3 and subsequent reduction to UO_2 at comparatively low temperatures. Further high temperature firing of the loose UO_2 powder in hydrogen causes extensive grain growth due to sintering. It is indeed remarkable that the influence of the physical state of the starting precipitate reaches as far as the later stage of the sintering process at the elevated temperatures, growth of the resulting UO_2 being profoundly affected accordingly. In order to attain rapid growth and densification of resulting UO_2, it was found essential to lower the U concentration of initial $UO_2(NO_3)_2$ solution in ADU precipitation. (auth)

17807 THE FORMATION OF URANIA–THORIA SOLID SOLUTION. M. D. Karkhanavala and A. C. Momin (Atomic Energy Establishment, Trombay, India). J. Nucl. Mater., 11: 114-16(Jan. 1964).

An analysis of the reaction of U_3O_8 with ThO_2 in air near 1300°C indicates that the reaction proceeds as follows: $1/3\ U_3O_8 + 1/6\ O_2(g) \rightarrow UO_3(g)$; then $UO_3(g)\ ThO_2 \rightarrow (UTh)O_2$. (T.F.H.)

17808 STUDIES ON COORDINATION COMPOUNDS OF URANYL ACETATE WITH SOME ORGANIC SUBSTANCES. THE SYSTEM: URANYL ACETATE–PYROCATECHOL–WATER. S. K. Misra, Subodh N. Kapoor, and C. S. Pande (Lucknow Univ., India). J. Prakt. Chem., 22: 329-36(Dec. 1963).

Conductometric, colorimetric, and pH observations of the mixed solutions of uranyl acetate and pyrocatechol revealed the existence of two complexes at (1 : 1) and (1 : 2) molecular ratios. The (1 : 1) compound was isolated and its uranium and pyrocatechol contents estimated. (auth)

17809 REDUCTION OF URANOUS-URANIC OXIDE BY AMMONIA. V. M. Zhukovskii and V. G. Vlasov (Kirov Ural Polytechnic Inst., USSR). Kinetika i Kataliz, 5: 76-81(Jan.-Feb. 1964). (In Russian)

The kinetics of the reduction of uranous-uranic oxide (U_3O_8) by ammonia was studied at 500 to 650° and P_{NH_3} = 25 to 600 mm Hg. The magnitude of the apparent activation energy is E = 50.5 ± 4.5 kcal/mole. The rate of the process as a function of P_{NH_3} at constant temperature is $v = k.P^n_{NH_3}$ (where n = 0.35 and 0.42). The phase transformations in the reduction of U_3O_8 by ammonia at the temperatures investigated are described by the following equation: $U_3O_8 \rightarrow U_3O_{8-x\,max} \rightarrow U_4O_9 \rightarrow UO_{2+x\,max} \rightarrow UO_{2+x}$. (R.V.J.)

17810 ELECTRONIC STRUCTURE OF XENON DIFLUORIDE. J. Bilham and J. W. Linnett (Oxford Univ.). Nature, 201: 1323(Mar. 28, 1964).

The results of calculations relating to the electronic structure of XeF_2 are reported. The treatment is of the four electrons associated with a framework $F^+Xe^{2+}F^+$. The wave functions of the molecule were constructed from the $2p_z$ orbitals of the two fluorine atoms and the $5p_z$ orbital on the xenon atom. The three atoms are in a straight line along the z-axis. It was assumed that other atomic orbitals can be neglected. (C.E.S.)

17811 NUCLEAR MAGNETIC RESONANCE OF H^1 AND Nb^{93} IN THE NIOBIUM–HYDROGEN SYSTEM. David Zamir and R. M. Cotts (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 134: A666-75(May 4, 1964).

The nuclear magnetic resonance of H and ^{93}Nb were observed in the NbH_x system as a function of hydrogen concentration and temperature. It is shown that line narrowing of the steady-state absorption resonance is limited at high temperatures by inhomogeneous broadening due to a distribution of fields caused by bulk paramagnetism of the samples. A sharp, though not discontinuous, change of hydrogen diffusion is observed at temperatures that range from 60 to 100°C and that depend on hydrogen concentration. Niobium resonance linewidth and intensity changes indicate that sharp change in proton diffusion is associated with the phase transition to the high-temperature cubic phase of the hydrides. The activation energy of $NbH_{0.7}$ is E_a = 5 kcal/mole in the low-temperature (orthorhombic) phase and E_a = 3.7 kcal/mole in the high-temperature (cubic) phase. The niobium resonance is observable at all hydrogen concentrations. As the hydrogen concentration increases, the Nb Knight shift decreases. The fractional change in shift is $\Delta K/K = -9\%$ at $NbH_{0.7}$. (auth)

17812 DEPENDENCE OF NUCLEAR QUADRUPOLE RELAXATION TIMES IN IONIC CRYSTALS ON THE PHONON SPECTRUM. S. K. Joshi (Univ. of Allahabad, India), R. Gupta, and T. P. Das. Phys. Rev., 134: A693-700(May 4, 1964).

Nuclear quadrupole relaxation times are calculated for the halogen and alkali nuclei in a number of alkali halides using lattice phonon density curves computed by Karo. The calculated values of T_1 at room temperature are generally lower than those obtained using the Debye model and is in better agreement with experiment. The variation of T_1 with temperature was also calculated over the range 20°K to room temperature for ^{23}Na and ^{27}I nuclei in NaI. Excellent agreement is obtained with the experimental data on the temperature variation of T_1 when use is made of the Karo distribution function. The Debye model gives a temperature variation comparable with experimental above 70°K but a relatively slower variation below 70°K. (auth)

17813 THE ADSORPTION OF NORMAL AND EQUILIBRIUM HYDROGEN AND DEUTERIUM AT LIQUID HYDROGEN TEMPERATURES ON GLASS. A. Van Itterbeek, R. Hellemans, and W. Van Dael (Instituut voor Lage Temperaturen en Technische Fysica, Louvain, Belg.). Physica, 30: 324-32(Feb. 1964).

Adsorption isotherms are measured of $n-H_2$, $e-H_2$, $n-D_2$, and $e-D_2$ on glass surfaces at 20 and 17°K. A preferential adsorption is found for $o-H_2$ and $p-D_2$. Isosteric heats of adsorption, Q_{ads}, were calculated. It is pointed out that there is a difference in Q_{ads} between the ortho and para modifications that may be explained by a loss of the rotational energy during the adsorption process. (auth)

17814 NUCLEAR QUADRUPOLE RELAXATION TIME. J. Zak (Israel Inst. of Tech., Haifa). Physica, 30: 401-6 (Feb. 1964).

A general nuclear quadrupole relaxation time dependence on the nuclear spin and the angles of the magnetic field with the crystal axes is derived. It is shown that in crystals belonging to the cubic system the relaxation time is isotropic. (auth)

17815 PLATINUM-LINED FURNACE FOR THE FLUORINATION OF URANIUM COMPOUNDS. FEATURES OF DESIGN AND CONSTRUCTION. Platinum Metal Rev., 8: No. 1, 12-13(Jan. 1964).

Brief description is given of a furnace designed for the fluorination of uranium compounds. A furnace liner was required that would be unaffected by hydrogen fluoride gas at 1000°C, would protect the charge from contamination by preventing the formation of corrosion products inside the furnace chamber, and would itself be unaffected by contact with uranium compounds. To fulfill these conditions a sheet of platinum 0.010 in. thick was selected to sheath the furnace chamber, the purge outlet and inlet tubes, and the chamber lid. (Uranium Abstr., 3: March 1964)

17816 INVESTIGATION OF THE CONDITIONS FOR OBTAINING ZIRCONIUM NITRIDE AND HYDRIDE DIRECTLY FROM THE DIOXIDE. G. A. Meerson and S. Roi (Inst. of Steel and Alloys, Moscow). Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 6, 71-7(Nov.-Dec. 1963). (In Russian)

Conditions for the reduction of ZrO_2 by magnesium in various gases, argon, hydrogen, and nitrogen, for the direct formation of zirconium hydride and nitride were investigated and compared. (auth)

17817 ELECTRONIC AND VIBRATIONAL RAMAN SPECTRA OF $PrCl_3$ AND $LaCl_3$. J. T. Hougen and S. Singh (National Research Council, Ottawa). Proc. Roy. Soc. (London), Ser. A, 277: 193-205(Jan. 21, 1964).

A search for electronic Raman transitions in the Pr^{3+} ion in $PrCl_3$ has yielded ten lines, which have been assigned as transitions from the ground Stark level of the $^3H_4$ state of the free Pr^{3+} ion to: (i) three other Stark levels of the $^3H_4$ state; (ii) five Stark levels of the $^3H_5$ state; and (iii) two Stark levels of the $^3F_2$ state. The frequencies and the polarizations of these lines are in agreement with the known energy levels of the Pr^{3+} ion. During the course of this work the frequencies of five of the six Raman active vibrational modes of crystals of both $PrCl_3$ and $LaCl_3$ were also determined. Only one A_g mode escaped detection. (auth)

17818 THE SPECTRUM OF Tm III IN CaF_2. B. Bleaney (Univ. of Pittsburgh). Proc. Roy. Soc. (London), Ser. A, 277: 289-96(Feb. 11, 1964).

The crystal field of CaF_2 is evaluated on a point-charge model, and from comparison with the crystal field constants derived from the optical spectrum (Kiss 1962) of Tm III in CaF_2, empirical values of $\langle r^4 \rangle = 4.3$ a.u., $\langle r^6 \rangle = 36$ a.u. are found. These are considerably larger than the estimates of Freeman & Watson (1962). The crystal field data reveal a small discrepancy with the paramagnetic resonance data of Hayes & Twidell (1961), which can be resolved by the introduction of an orbital k-factor which is slightly less than unity ($1 - k = 0.009 \pm 0.001$). Comparison with the spectrum of Tm I measured by atomic beams (Ritter 1962) shows that the magnetic hyperfine constant for a free Tm III ion is 2.2 ± 0.5% greater, while the spin-orbit coupling is 1.2% greater, assuming a core polarization correction of the same magnitude as that measured for Eu III in CaF_2. Similar effects are shown to occur for Ho III in CaF_2. The results suggest that the values of $\langle r^{-3} \rangle$ and the spin-orbit coupling parameter ζ are only about 1 to

2% greater for the free divalent 4f ions than for the atoms. (auth)

17819 ISOTOPE SHIFTS IN THE Nd I SPECTRUM. P. R. Rao (Atomic Energy Establishment, Trombay, India) and G. Gluck. Proc. Roy. Soc. (London), Ser. A, 277: 540-8(Feb. 25, 1964).

Isotope shifts in about fifty lines of the Nd I spectrum emitted by a hollow cathode tube, in the region 5200 to 6000 Å, were recorded on a Fabry-Perot spectrometer equipped with a photoelectric detector. The results are used to examine the existing classification of the spectrum. The structure of the line 5525.7 Å suggests the inversion of the odd–even staggering phenomenon for ^{145}Nd. (auth)

17820 THE ADSORPTION OF WATER FROM CONCENTRATED ELECTROLYTE SOLUTIONS BY MONTMORILLONITE AND ILLITE. A. M. Posner and J. P. Quirk (Univ. of Adelaide). Proc. Roy. Soc. (London), Ser. A, 278: 35-56(Mar. 10, 1964).

Isotherms were obtained for the adsorption of water from a number of electrolyte solutions (0.7 molal to near saturation) on montmorillonite and illite. The interlamellar volumes of the montmorillonite at various points on the isotherms were calculated from x-ray diffraction results. For some systems isotherms were measured at three temperatures. Attempts to account for the shapes of the isotherms by means of a simple Donnan equilibrium causing exclusion of ions from the surface region were not successful. The isotherms usually show three discontinuities with increasing electrolyte concentration, corresponding to the inability of electrolyte to penetrate into three surface regions until particular concentrations have been exceeded. One of these regions corresponds to the primary hydration shell of the exchangeable cations. Entry of electrolyte into the other regions is governed by the image force between the ions and the surface region and hence the difference between the dielectric constant of the bulk and surface water. When these approach equality, entry is controlled by the need for electrolyte ions to undergo suitable ion pairing and to decrease the entropy of an already ordered surface rendering it more like the electrolyte solution. The ability of an electrolyte to enter the surface regions is correlated with the balance between the relative structure making and breaking power of an ion. The free energy of penetration of an electrolyte into the adsorbed water increases with decreasing hydration. Thus adsorption of water on illite from caesium chloride solutions does not occur over the concentration range used. The similarity of the results obtained for illite with predominantly external surfaces, and montmorillonite with predominantly internal surfaces, is of special significance. It indicates that the adsorption of two layers of water provides the bulk of the energy for intercrystalline swelling which is common to all clays. (auth)

17821 REVERSIBLE AND IRREVERSIBLE PROCESSES AT THE DROPPING MERCURY ELECTRODE. XIII. Nd^{+3}, Gd^{+3}, Tb^{+3}, Ho^{+3}, Er^{+3}, Tm^{+3}, and Lu^{+3}. J. Almagro, V. Almagro, and J. Sancho (Instituto A. de G. Rocasolano, Facultad de Ciencias, C.S.I.C., Murcia, Spain). Publs. Inst. Quim. Fis. "Rocasolano," 16: 131-40(1962). (In Spanish)

A polarographic study of Nd^{3+}, Gd^{3+}, Tb^{3+}, Ho^{3+}, Er^{3+}, Tm^{3+}, and La^{3+} ions was carried out in support solution of LiCl 0.1M, gelatine 0.1%, in the presence of 25, 50, and 75% ethyl alcohol. Only one wave was observed corresponding to a process $M^{3+} + 3e^- = M^0$, which was verified in all elements by means of the respective microcoulombimetric study. The observed waves are well defined and useful for analytical studies, wherefore the corrected potentials (referred SCE) and the values of the diffusion ocurrent constant are given. The waves were also studied for different conditions of pH and temperature. Finally, the elements were studied by derivative polarography and it was proved that the variations in wave heights and concentrations are strictly linear between 1×10^{-3} and 3×10^{-3} M. This method is also of interest for discussing the reduction mechanism of the ions mentioned. (auth)

17822 XENON FLUOROSILICATE AND RELATED COMPOUNDS. A. F. Clifford and G. R. Zeilenga (Purdue Univ., Lafayette, Ind.). Science, 143: 1431(Mar. 27, 1964).

The reaction product of Xe, F_2, and SiF_4 in a glow discharge is shown to have a composition approximating Xe_2SiF_8. It and a similar hexafluorophosphate are unstable at room temperature. A stable hexafluoroantimonate is formed from Xe, F_2, and SbF_5 at 250°C. (auth)

17823 MÖSSBAUER EFFECT FOR SURFACE ATOMS: IRON-57 AT THE SURFACE OF η Al_2O_3. P. A. Flinn (Westinghouse Research Labs., Pittsburgh), S. L. Ruby, and W. L. Kehl. Science, 143: 1434-6(Mar. 27, 1964).

The Mössbauer effect was observed for ^{57}Fe atoms at the surface of η Al_2O_3. The ^{57}Fe is trivalent, and the quadrupole splitting found is consistent with a surface location. Anisotropy of thermal vibration relative to the surface was observed. (auth)

17824 SPONTANEOUS DISLOCATION JUMPS IN LITHIUM FLUORIDE SINGLE CRYSTALS. V. B. Pariiskii, A. I. Landau, and V. M. Borzhkovskaya (Khar'kov Low-Temperature Physicotechnical Inst.). Soviet Phys.-Solid State (English Transl.), 5: 1876-9(Mar. 1964).

The spontaneous abrupt movement of dislocations in LiF single crystals which, at the time of the motion, are not subjected to any external influence is investigated. By statistical treatment of the experimental data it is shown that this motion in fact has an abrupt character and is connected with the overcoming of local barriers by a moving dislocation. An experimental relation is obtained between the mean length of the spontaneous displacement of the dislocations and the relaxation time in the single crystal. On the basis of the experimental data, the mean stopping time of the dislocations between successive jumps is evaluated. (auth)

17825 ABSORPTION SPECTRA OF TRIVALENT LANTHANIDE IONS IN AQUEOUS SOLUTION IN THE NEAR INFRARED REGION. Masato Mamiya. Tokyo Kogyo Shikensho Hokoku, 59: 13-16(Jan. 1964). (In Japanese)

Near infrared absorption spectra of fourteen trivalent lanthanide ions in water-dioxane mixture and deuterium oxide solution were studied in the range of 1.4 to 1.8 μ. Of these, praseodymium, samarium, dysprosium, erbium, and thulium have characteristic absorptions of the above ions arising from 4f-4f transition of inner electron shell as in the case visible and ultraviolet absorptions, and any change in the features of their spectra was not found, when the solvent water was replaced by oxide. The molecular extinction coefficients for the above ions were calculated, but sufficiently accurate values could not be obtained because the bands superposed on that of water contained as crystalline water in the sample salts. It proved to be impossible to exclude water completely even by deuterium substitution. Spectrophotometric data for

praseodymium, samarium, dysprosium, erbium, and thulium in deuterium oxide solution were obtained using a Cary model 14 spectrophotometer and are tabulated. All absorption maxima obeyed the Beer's law to a satisfactory degree, indicating that these absorption peaks could be used for analytical purpose as well as other purposes. (auth)

17826 STUDIES ON THE COMPLEXES OF ALKALINE-EARTH METALS WITH CITRIC ACID, ISOCITRIC ACID, AND ALLOISOCITRIC ACID BY AN ION-EXCHANGE METHOD. Zenzo Tamura and Yoshikazu Matsushima (Tokyo Univ.). Yakugaku Zasshi, 82: 1569-71(Nov. 1962). (In Japanese)

Stability constants of the complexes formed between alkaline earth metals and three forms of citric acid were determined using Amberlite IR-120 resin and ^{45}Ca, ^{90}Sr, and ^{133}Ba. Comparison of these results with those of biological studies suggests that the values of K_{Sr}/K_{Ca} are more important than the stability constants themselves for the effective excretion of radiostrontium from the body. The stability constants (log K values) of the complexes with citric, isocitric, and alloisocitric acids were as follows: for the Ca complex 3.15, 2.28, 1.91; for Sr 2.75, 1.81, 1.49; and for Ba 2.55, 1.80, ~1. The molar ratio of all complexes was 1:1 and all measurements were carried out in ionic strength 0.156 diethylbarbiturate buffer at 25°C with organic acid concentrations of 0.5 to 5 m$\underline{M}$. (BBB)

17827 ON LITHIUM AND SODIUM URANATES(V) AND ON STRUCTURAL RELATIONS BETWEEN THE COMPOUND TYPES Li_7AO_6 AND Li_8AO_6. R. Scholder and H. Glaeser (Technische Hochschule, Karlsruhe, Ger.). Z. Anorg. Allgem. Chem., 327: 15-27(Feb. 1964). (In German)

The colored uranates(V) Li_3UO_4, Li_7UO_6, and Na_3UO_4 (the latter one being probably the most basic compound in the system $Na_2O-U_2O_5$) were thermally prepared. Their properties are described. Li_7UO_6 is isotypic with other compounds having the general formula $Li_7A^{V}O_6$ (A = Sb, Bi, Nb, Ta, Ru, Os); its powder diagram is very similar to those of $Li_8A^{IV}O_6$ compounds (A = Sn, Pb, Zr, Hf, Ir, Pt). Further uranates(V) were obtained from UO_2, Li_2O, and Na_2O respectively, and by reduction of Li_2UO_4 and Na_2UO_4 by means of H_2. Alkali uranates(IV) seemed to be unstable. (auth)

17828 INVESTIGATIONS ON ZIRCONIUM COMPOUNDS OF LOW VALENCES. III. PREPARATION OF PURE ZIRCONIUM TRICHLORIDE. H. L. Schlaefer and H.-W. Wille (Universität, Frankfurt am Main). Z. Anorg. Allgem. Chem., 327: 253-9(Feb. 1964). (In German)

Zirconium trichloride ($ZrCl_3$) was prepared by reaction of finely powdered zirconium metal with an excess of $ZrCl_4$ in a special tube at a temperature of 500°C and a pressure of about 60 atm. (auth)

17829 ON THE TEXTURE OF HYDROGEN ISOTOPE LAYERS CONDENSED ON A COLD BACKING. V. S. Kogan, A. S. Bulatov, and L. F. Yakimenko (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 46: 148-52(Jan. 1964). (In Russian)

A comparison of x-ray patterns for hydrogen isotope samples condensed inside a beryllium tube and on the surface of a copper rod shows that the latter have a texture which is different from hydrogen and deuterium layers. The presence of the texture requires a reappraisal of the data pertaining to their structure. Such a reappraisal results in the conclusion that both isotopes possess a hexagonal structure with a somewhat different axes ratio c/a. (auth)

17830 HYPERINE STRUCTURE OF THE EPR LINES OF THE V^{50} AND V^{51} ISOTOPES. N. S. Garifyanov and S. E. Kamenev (Kazan State Univ.). Zh. Eksperim. i Teor. Fiz., 46: 501-4(Feb. 1964). (In Russian)

The isotropic and anisotropic hyperfine structure of the EPR lines in liquid and supercooled solutions of VOF_2 and $VOCl_2$ compounds in concentrated hydrofluoric and hydrochloric acids due to the ^{50}V and ^{51}V isotopes is studied at a frequency v = 9320 M and at temperatures 295 and 77°K. The isotopic and anisotropic hyperfine structure constants are determined. The results are qualitatively compared with the theory. (auth)

17831 HEATS OF FORMATION OF CALCIUM, STRONTIUM AND BARIUM METAZIRCONATES. A. S. L'vova and N. N. Feodos'ev. Zh. Fiz. Khim., 38: 28-32(Jan. 1964). (In Russian)

Using the calorimetric bomb method with carbon black as initiator, the heats of formation of calcium, strontium, and barium zirconates were determined from zirconium dioxide and the corresponding carbonates to be 35.2 ± 0.2, 38.2 ± 0.2, and 34.4 ± 0.4 kcal/mole. From these values and previously determined data the heats of formation of the zirconates from the oxides and elements and the change in the isobaric potential corresponding to these reactions were calculated. (auth)

17832 MEASUREMENTS OF TRANSPORT NUMBER IN URANYL CHLORIDE AQUEOUS SOLUTIONS. E. A. Kaimakov and I. V. Basargin (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Fiz. Khim., 38: 203-4(Jan. 1964). (In Russian)

The cation transport numbers in 0.85 to 3.01$\underline{M}$ UO_2Cl_2 solutions at 20, 40, and 60°C were studied by observing ion and solution motion. At concentrations over 3$\underline{M}$ the temperature coefficient is ~0.4%/degree. (R.V.J.)

17833 TEMPERATURE EFFECTS ON PLUTONIUM(IV) COMPLEXING IN NITRATE SOLUTIONS. B. G. Pozharskii, I. A. Fedorov, and V. B. Shevchenko. Zh. Neorgan. Khim., 9: 279-82(Feb. 1964). (In Russian)

Studies of temperature effects on the complexing of Pu(IV) in nitrate solutions showed that with increased temperature Pu(IV) undergoes a more vigorous complexing with nitrate ions owing to a more rapid weakening of the bond, between the water molecule of the hydrate medium than between the Pu and the nitrate groups. (R.V.J.)

17834 OXALATE AND MIXED URANIUM(IV) COMPOUNDS. V. A. Golovnya and G. T. Bolotova (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 9: 283-94(Feb. 1964). (In Russian)

Thermographic studies were made of oxalates and mixed uranium compounds: $U(C_2O_4)_2 \cdot 6H_2O$, $U_2(C_2O_4)_3Cl_2 \cdot 12H_2O$, $U_2(C_2O_4)_3SO_4 \cdot 12H_2O$, $UC_2O_4SO_4 \cdot 3H_2O$, $H_2U_2(C_2O_4)_5 \cdot 8H_2O$, $(NH_4)_2U_2(C_2O_4)_5 \cdot 8H_2O$, and of newly synthesized compounds: $U(C_2O_4) \cdot 2CO(NH_2)_2$, $U(C_2O_4)_2 \cdot 3CO(NH_2)_2 \cdot H_2O$, $(CN_3H_6)_2U_2(C_2O_4)_5 \cdot 4H_2O$, $(NH_4)_4 \cdot [U(C_2O_4)_4] \cdot 3H_2O$, $(CN_3H_6)_4[U(C_2O_4)_4] \cdot 2H_2O$, $Rb_4U_2(C_2O_4)_3(SO_4)_3 \cdot 6H_2O$, $Rb_6U_2(C_2O_4)_3(SO_4)_4 \cdot 4H_2O$, and $(NH_4)_6U_2(C_2O_4)_3(SO_4)_4 \cdot 4H_2O$. It was shown that the compounds are a series of complex genetically bound compounds retaining a constant coordinate number for U(IV) equal to 8. The saturation of lower level series is accomplished by water molecules and by increased coordination of oxalate groups forming polynuclear structures. (R.V.J.)

17835 ON MIXED THORIUM ACID COMPLEXES. A. K. Molodkin, O. M. Ivanova, and G. A. Skotnikova. Zh. Neorgan. Khim., 9: 295-306(Feb. 1964). (In Russian)

Studies of carbonate and oxalate compounds of thorium indicated that tetraoxalatethorates $Me_4Th(C_2O_4)_4 \cdot nH_2O$ (where Me = metal) and pentacarbonate thorates $Me_6Th(CO_3)_5 \cdot nH_2O$ are soluble in carbonates, oxalates, and fluorides of alkali metals, and in ammonia and guanidine. Mixed acid complexes of thorium were synthesized as follows: $(CN_3H_6)_6Th_2(CO_3)_7C_2O_4 \cdot 6H_2O$, $(CN_3H_6)_3NH_4Th(CO_3)_3C_2O_4 \cdot 1.5H_2O$, $(CN_3H_6)_4Th(CO_3)_3C_2O_4 \cdot nH_2O$, $(CN_3H_6)_6Th_2(CO_3)_7(C_2O_4)_3 \cdot 14H_2O$, $(CN_3H_6)_8Th_2(CO_3)_5(C_2O_4)_3$, $(CN_3H_6)_3NH_4Th(CO_3)_2(C_2O_4)_2 \cdot 3H_2O$, $NH(CN_3H_6)_4Th(CO_3)_3F_3$, and $K_4Th(C_2O_4)_2F_4$. Genetic families of carbonate, carbonate-oxalate and oxalate thorium complexes and transition series from carbonate compounds into oxalates were investigated. It is shown that saturation of solutions with carbonate groups results in the formation of thorium pentacarbonates and saturation with oxalate groups forms thorium tetraoxalates. Mutual transitions $Me_6Th(CO_3)_5 \cdot nH_2O \rightleftharpoons Me_4Th(C_2O_4)_4 \cdot nH_2O$ are also possible. (R.V.J.)

17836 PREPARATION AND PROPERTIES OF RHENIUM MONOCHLORODIACETATE. A. S. Kotel'nikova and G. A. Vinogradova (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 9: 307-11(Feb. 1964). (In Russian)

Reactions of rhenium dichloromonoacetate [$ReCl_2 \cdot CH_3COOH \cdot H_2O$], with acetic acid at 250° in inert gas media results in the replacement of only two chlorine atoms. The product of the reaction exhibited a stronger Re–Cl bond stability. The preparation and diamagnetic properties of separated compounds suggest dimerization along the Re–Re bond. New compounds of $Re_2Cl_3 \cdot 3CH_3COOH \cdot H_2O$ and $(ReCl \cdot 2CH_3COOH)_2$ were prepared and their properties were analyzed. Rhenium monochloride $(ReCl \cdot 2CH_3COOH)_2$ has the highest chemical and thermal stability in comparison to other acetate derivatives. (R.V.J.)

17837 ZIRCONIUM AND HAFNIUM COMPOUNDS WITH TRICHLOROACETIC ACID. I. A. Sheka, S. A. Kacherova, and L. A. Malinko (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Zh. Neorgan. Khim., 9: 312-19(Feb. 1964). (In Russian)

The reactions of trichloroacetic acid with zirconium and hafnium in hydrochloric and nitric acid solutions and infrared absorption spectra of zirconium and hafnium trichloroacetates were investigated. Zirconium and hafnium trichloroacetates, $Zr(OH)_2(CCl_3COO)_2$ and $Hf(OH)_2 \times (CCl_3COO)_2$, were prepared. It was suggested that zirconium and hafnium trichloroacetates in the solid state retain $Zr(OH)_2^{2+}$ and $Hf(OH)_2^{2+}$ ions. (R.V.J.)

17838 RARE EARTH NITRILOTRIACETATE HYDRATES. N. D. Mitrofanova, L. I. Martynenko, and A. I. Grigor'ev (Moscow State Univ.). Zh. Neorgan. Khim., 9: 320-9(Feb. 1964). (In Russian)

Thermogravimetric, x-ray, and infrared analyses were made to determine the properties and structure of complex hydrates: LaX, PrX, NdX, GdX, YX, ErX, and YbX. Complexes of cerium subgroup elements and gadolinium form hydrates with five, four, and three (three types) water molecules while yttrium subgroup elements form only tetrahydrates (three types). Water molecules in different types of hydrates have different bond stabilities. Nitrilotriacetic acid groups in nearly all rare earth nitrilotriacetates have only an ionic bond and in high-temperature trihydrates (LaX, PrX, and NdX) they exhibit coordination and ion bond acetate groups. (R.V.J.)

17839 ON RARE EARTH OXYFLUORIDES. L. R. Batsanova and G. N. Kustova (Inst. of Inorganic Chemistry, Academy of Sciences, Siberia SSR). Zh. Neorgan. Khim., 9: 330-4(Feb. 1964). (In Russian)

An x ray analysis was made of the density and refractive indices of LaOF, PrOF, NdOF, GdOF, DyOF, SmOF, and YOF prepared by various methods. Infrared spectra of the rare earth oxyfluorides were studied and intense absorption was observed at 400 to 550 cm^{-1}. (R.V.J.)

17840 SYNTHESIS OF ERBIUM PHTHALOCYANINES. V. E. Plynishchev and L. P. Shklover. Zh. Neorgan. Khim., 9: 335-9(Feb. 1964). (In Russian)

Erbium phthalocyanine was prepared by heating erbium chloride pentahydrate, $ErCl_3 \cdot 5H_2O$, with four moles of o-$C_8H_4(CN)_2$. The formula of the erbium phthalocyanine prepared, $C_{32}H_{16}N_8 \cdot ErCl \cdot 2H_2O$, was determined and verified. Studies of erbium phthalocyanine absorption spectra in α-bromonaphthalene at 400 to 700 mμ showed the long wave band maximum at 667 mμ. (R.V.J.)

17841 SYNTHESIS AND PURIFICATION OF SAMARIUM AND ERBIUM PHTHALOCYANINES. L. P. Shklover and V. E. Plyushchev. Zh. Neorgan. Khim., 9: 340-6(Feb. 1964). (In Russian)

Thermographic analysis was made of the synthesis and purification processes of samarium phthalocyanine and of the behavior of erbium phthalocyanine during precipitation from concentrated H_2SO_4. (R.V.J.)

17842 REACTIONS IN THE SYSTEM BaO–BeO. E. N. Isupova and E. K. Keler. Zh. Neorgan. Khim., 9: 394-402 (Feb. 1964). (In Russian)

Thermal, phase, chemical, microscopic and x-ray analyses were made of the reaction between BaO and BeO at 900 to 1300°C and a phase analysis of the reaction products was made at various temperatures. It was found that the BaO–BeO system has two compounds $Ba_2Be_3O_5$ and $BaBe_3O_4$. The melting point of $Ba_2Be_3O_5$ is 1725°C and of $BaBe_3O_4$ is 1540°. The $BaBe_3O_4$ formed at 1280°C and at 1200°C is disintegrated into $Ba_2Be_3O_5$ and BeO. The optical density and chemical properties of the compounds were determined and parameters of the $Ba_2Be_3O_5$ lattice were calculated. (R.V.J.)

17843 REACTIONS OF THE SYSTEM BaO–BeO–SiO_2. E. N. Isupova and E. K. Keler. Zh. Neorgan. Khim., 9: 403-13(Feb. 1964). (In Russian)

Reactions in the system BaO–BeO–SiO_2 were studied and properties of the newly formed beryllosilicates were determined. Two ternary compounds, $BaBeSiO_4$ and $BaBe_2Si_2O_7$, were prepared from the system. It was found that the physicochemical properties coincide with the properties of the mineral barylite. Chemical analysis was made of the two compounds and conditions for the synthesis of $BaBeSiO_4$ and $BaBe_2Si_2O_7$ were studied as functions of temperature and the heating period. (R.V.J.)

17844 MELTING DIAGRAMS FOR SAMARIUM AND YTTERBIUM CHLORIDES WITH POTASSIUM CHLORIDE. G. I. Novikov, O. G. Polyachenok, and S. A. Frid. Zh. Neorgan. Khim., 9: 472-5(Feb. 1964). (In Russian)

Melting diagrams constructed for the systems $SmCl_3$–KCl, $SmCl_2$–KCl, $YbCl_3$–KCl, and $YbCl_2$–KCl showed complexing in both solid and liquid states. It was also shown that KCl does not have any effect on the relative stability of di- and trichlorides except of $NdCl_2$ in which the stability is improved. (R.V.J.)

17845 SCANDIUM THIOCYANATES. L. N. Komissarova, A. A. Krasnoyarskaya, and V. G. Guliz (Moscow

State Univ.). Zh. Neorgan. Khim., 9: 477-9(Feb. 1964). (In Russian)

Synthesis of the scandium thiocyanates $Sc_4(CNS)_{10}(OH)_2 \cdot nH_2O$ and $Sc(CNS)_3 \cdot 3C_2H_5OH$ from aqueous and alcohol solutions was investigated. Twice recrystallized barium thiocyanate was made to react with anhydrous scandium chloride with <0.01% admixtures. Scandium sulfate tetrahydrate was prepared by the reaction of sulfuric acid with Sc_2O_3. The compound $Sc_4(CNS)_{10}(OH)_2 \cdot nH_2O$ was hygroscopic with a specific gravity of 1.591 g/cm^3 and a solubility of 96.05 wt % at 20 ± 0.1. The compound is easily soluble in organic compounds; at 450° it disintegrates into Sc_2O_3. (R.V.J.)

17846 COMPLEX FORMATION OF ZIRCONIUM AND HAFNIUM WITH NITRILOTRIACETIC ACID. A. N. Ermakov, I. M. Marov, and G. A. Evtikova. Zh. Neorgan. Khim., 9: 499-501(Feb. 1964). (In Russian)

The complexing of Zr^{4+} and Hf^{4+} ions with nitrilotriacetic acid in highly acid medium was studied using ion exchange methods. It was found that 1:1 ratio complexes form in 1 and 2 mole $HClO_4$ solution in the presence of H_3A. Constants for HfA^+ complexes $(0.68 \pm 0.03) \times 10^4$ and $(1.2 \pm 0.1) \times 10^4$ (2 mole $HClO_4$) and for ZrA^+ $(11.2 \pm 2.0 \times 10^4$ and $(27.4 \pm 2.6) \times 10^4$ were found. It was also found that three hydrogen ions split away in the H_3A reaction with Zr^{4+} and Hf^{4+}. (R.V.J.)

17847 COMPLEXING OF ZIRCONIUM AND HAFNIUM WITH DIETHYLENTRIAMINOPENTA-ACETIC ACID. A. N. Ermakov, I. N. Marov, and G. A. Evtikova. Zh. Neorgan. Khim., 9: 502-5(Feb. 1964).

The composition and equilibrium constants of zirconium and hafnium complexes with diethylenetriaminepentaacetic acid (H_5P) were studied using an ion exchange method in a highly acid medium. It was found that five ions of hydrogen break away in the H_5P reaction with Zr^{4+} and Hf^{4+}. The formation constants for ZrP and HfP are equal to $(13.8 \pm 1.9) \times 10^4$ and $(4.3 \pm 0.3) \times 10^4$, respectively. (R.V.J.)

17848 THE CHEMISTRY OF BERYLLIUM. D. A. Everest. Topics in Inorganic and General Chemistry, Volume 1. New York, Elsevier Publishing Company, 1964. 158p. $8.00.

Information is included on: general chemistry of Be; solution chemistry of the Be^{2+} ion; simple oxosalts of Be; beryllium halides; complex beryllium compounds; simple binary compounds of Be; organo-beryllium compounds; extractive metallurgy of Be; analytical chemistry of Be; beryllium health hazard and its control; and nuclear properties and reactions of Be. (P.C.H.)

17849 METHOD OF PREPARING STRONTIUM TITANATE. (to U. S. Atomic Energy Commission). British Patent 953,963. Apr. 2, 1964. Priority date Oct. 31, 1961, United States.

A method for preparing $SrTiO_3$ for radioisotope-fueled thermoelectric generators, is described which is carried out at a comparatively low temperature, does not involve any powder containment problems, and results in a high Sr density in the product. The method comprises preparing a solution of $TiO(NO_3)_2$ and $Sr(NO_3)_2$ with the $TiO(NO_3)_2$ in slight excess (~1.0 wt %), digesting the solution (pH 0.5 or less) at the boiling point to precipitate H_2TiO_3, adding H_2O_2 in an amount in excess of that required to convert the Sr into SrO_2, adding NaOH to precipitate SrO_2, separating the mixed $H_2TiO_3 - SrO_2$ precipitate from the solution, and igniting the mixed precipitate at 400 to 800°C to obtain $SrTiO_3$. (D.L.C.)

17850 METHOD OF PREPARING RARE EARTH SULFIDES. L. Ya. Markovskii, E. Ya. Pesina, and R. I. Smirnova. Russian Patent 158,267.

A method for preparing rare earth sulfides by sulfurizing the rare earth oxides with a mixture of carbon disulfide and inert gas is described. (OTS)

Organic Chemistry

17851 (CONF-441-1) PREPARATION OF MARKED OLEFINIC SUBSTANCES BY TRITIOBORATION PROCEDURES. R. F. Nystrom, Nguyen H. Nam, and A. J. Russo (Illinois. Univ., Urbana). [1963]. Contract [AT(11-1)-890]. 14p.

From the Conference on Methods of Preparing and Storing Marked Molecules, Brussels, Nov. 1963.

Syntheses for the conversion of 1-olefins to tritium-labeled 1-olefins were developed using tritioboration. The tritioboration of olefins results in organoboranes which are useful as synthetic intermediates for the preparation of tritium-labeled hydrocarbons, olefins, alcohols, etc. The synthesis of B_2T_6 is described, and results are reported for the tritioboration of 1-hexene and subsequent oxidation by H_2O_2–NaOH to give a main product of 1-hexanol-2-T. Tritioborated 1-hexene was also heated with 1-decene to effect a displacement reaction, and the effects of isomerization on the tritium labeling were studied. 1-Octene-1-C^{14} was reacted with B_2H_6 to study the tritium labeling pattern in previous tritioborations. The tritioboration and conversion of cyclohexene into tritium-labeled cyclohexene were studied. Tritium labeling by the Wilzbach method was studied using tricyclohexylborane. The preparation of 1-hexene-1-T and 1-hexene-2-T from 1-hexyne by reaction with disiamylborane and acetic acid, one of which is tritium-labeled, was carried out. Finally, the reaction of methyl stearolate with disiamylborane-T and acetic acid to give tritiated methyl oleate with the labeling in the 9- and 10-positions was studied. (D.L.C.)

17852 (UCRL-11046(p.90-100)) EPR STUDIES OF SOME COMPLEX ORGANIC SOLUTIONS. David F. Ilten, Maurits Kronenberg, and R. H. Ruby (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ. Berkeley. Dept. of Chemistry).

A study was made of photoinduced electron paramagnetic resonance (EPR) signals observed in solutions of chloranil in various organic solvents. Purification procedures for materials and a method for measuring EPR rise and decay times of the order of 20 msec are discussed. (C.H.)

17853 (UCRL-11046(p.116-51)) STUDIES ON THE TAUTOMERISM OF AMIDES. Lech Skulski and G. C. Palmer (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry).

To check the correctness of the assumption that N-(α-methylbenzyl)-benzamide exists predominantly in the iminol form in methanol solutions, a series of acyl (mostly acetyl and benzoyl) derivatives of optically active and racemic α-methylbenzylamines, 1,1-diphenylmethylamine, benzylamine, and N-methylbenzylamine were synthesized. N-deuterated analogs of these compounds were also prepared. Spectropolarimetric measurements of the optical rotary dispersion (ORD) of N-benzoyl-, N-acetyl-, N-formyl-, and N-trifluoroacetyl-α-methylbenzylamines were made in benzene and methanol solutions at 25°. The ORD curve of N,N-dibenzyl-α-methylbenzylamine in

methanol is included for comparison. The experimental observations reporting that the rotation of optically active N-(α-methylbenzyl)-benzamides is of opposite sign in methanol from what it is in benzene and other nonhydroxylic solvents were confirmed, as well as that of the existence of two different solid forms of these compounds. Data from proton nuclear magnetic resonance studies and examination of ultraviolet spectra of the compounds in various solvents led to the conclusion that the solvent effect on optical rotation must be accounted for in terms other than amide-iminol tautomerism. The best explanations would probably lie in the different intermolecular complexes (monomers vs dimers or polymers) formed in different solutions or in the different barriers to rotation about the amide bond, possibly resulting in different positions of the cis-trans equilibrium of the amides in different solvents. The two crystal forms can most likely be explained in terms of cis-trans isomerization about the amide bond or by different intermolecular complexes in the solid state. The amide-iminol tautomerism, although extremely unlikely, cannot be entirely ruled out as the cause of these two crystal forms. (auth)

17854 (UCRL-11046(p.159-98)) A STUDY OF THE IRRADIATION PRODUCTS OF SEVERAL NITRONES. Janet S. Splitter (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry).

Several N,α-diarylnitrones were investigated after exposure to light and in every case the first irradiation product was quite unstable, the stability varying according to substituent and solvent. The ultraviolet (uv) absorption spectra of the first irradiation products of nitrones in ethanol were very similar to those of oxaziridines. By a modified method, the first irradiation products from nitrones in ethanol contained a high percentage of active oxygen (measured by release of I_2 from KI). All the N,α-diarylnitrones produced first irradiation products that were rearranged or hydrolyzed or both, or reacted further in the dark to yield end products that varied in amount with different solvents. The spectra of nitrone, oxaziridine, and all the products resulting from oxaziridine, are presented. (C.H.)

17855 (UCRL-11046(p.207-9)) SYNTHESIS OF METHYL-β-D-THIOGALACTOSIDE-^{35}S. Mary de Paul Palaszek and Richard M. Lemmon (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry).

Procedures are described for the preparation of ^{35}S-labeled methylthiogalactoside. (C.H.)

17856 PYRIDINE N-OXIDE COMPLEXES OF ZIRCONYL, THORIUM, AND URANYL PERCHLORATES. P. Rama Murthy and C. C. Patel (Indian Inst. of Science, Bangalore). Can. J. Chem., 42: 856-60(Apr. 1964).

Pyridine N-oxide complexes having the composition $ZrO(Py.O)_3(ClO_4)_2$, $Th(Py.O)_3(ClO_4)_4$, and $UO_2(Py.O)_5(ClO_4)_2$ were prepared. The infrared and electronic absorption spectra show that the bonding between the metal and pyridine N-oxide in the complexes occurs by donation of the lone pair of p-electrons on oxygen to the metal, and that the π-bond character of NO group increases in the complexes as uranyl < thorium < zirconyl. The decrease in the vibrational structure of the UO_2^{2+} spectrum in the visible region indicates strong coordination of puridine N-oxide to the uranyl group. The decomposition temperatures of zirconyl, thorium, and uranyl complexes are 307, 350, and 319°C, respectively. (auth)

17857 PREPARATION OF GLUCOSE-6-PHOSPHATE UNIFORMLY LABELED WITH ^{14}C. Peppino Betto and Luige Longinotti (Centro Internazionale di Biochimica Generale e Microbiologia, Rome). Gazz. Chim. Ital., 93: 1191-5(Oct. 1963). (In Italian)

Uniformly labeled glucose was converted by yeast hexokinase to uniformly labeled glucose-6-phosphate and separated from fructose-6-phosphate and other products by ion-exchange chromatography. Thirty-one ml of a solution at pH 8.2 containing 25.2 mg of uniformly labeled glucose (0.5 mC), 125 mg of ATP Na salt, ~2 mg of hexokinase, and $MgCl_2$ (0.01M) was incubated 2 hr at 37°C. It was brought to 250 ml with H_2O and poured on a column (1.3-cm dia, 15-cm height) of 20 ml Dowex 1-X8, Cl^-, 200 to 400 mesh, at a rate of 0.5 ml/min. Then the column was washed with 20 ml H_2O. Elution of the sample was carried out at a rate of 1 to 2 ml/min using a series of solutions (a: 0.001M NH_4OH; b: 0.025M NH_4Cl, 0.01M $K_2B_4O_7$; c: 0.035M NH_4Cl, 0.001M $K_2B_4O_7$, 0.0025M NH_4OH; d: 0.04M NH_4Cl, 0.00001M $K_2B_4O_7$, 0.0025M NH_4OH; e: 1N HCl) described by Longinotti et al. Glucose-6-phosphate was eluted by solvent c; fructose-6-phosphate by solvent d; the radiometric chromatogram is illustrated. The products were purified by combining the fractions of each separately and then diluting 1:1 with H_2O. The solution was set on a column (1.7-cm dia, 25-cm height) of 55 ml Dowex 1-X8, $HCOO^-$, 200 to 400 mesh, at a rate of 0.5 to 1 ml/min. The column was washed with ~100-ml 0.0001M HCOOH and the compound eluted with 2 1 0.7N HCOOH at 1 ml/min. The fractions containing the radioactive peak were combined, and evaporated on a rotary evaporator (30 to 35°C) to a small volume. Then 50 ml H_2O was added and the process repeated three times, the sample finally being dried over P_2O_5 and KOH and extracted three times with 20 ml ethyl ether. Evaporation of the ether gave pure phosphate, the G-6-P containing 2405/4200 of the original activity and the F-6-P containing 425/4200 (expressed counts/min × 10^{-3}). (BBB)

17858 PREPARATION OF DEUTEROCHLOROFORM FROM TRICHLOROACETOPHENONE. G. Gopakumar and P. Madhavan Nair (National Chemical Lab., Poona, India). Indian J. Chem., 2: 128-9(Mar. 1964).

The yield of deuterochloroform obtained by the modified method is 88 to 93 per cent compared to 30 per cent obtained by previous methods. (auth)

17859 STABILITY CONSTANTS OF THE RARE EARTH CHELATE SPECIES FORMED WITH SOME MONOCARBOXYLATE LIGANDS. J. E. Powell, R. S. Kolat, and G. S. Paul (Ames Lab., Ames, Iowa). Inorg. Chem., 3: 518-20(Apr. 1964). (IS-755)

Formation constants of the first two chelate species formed by rare earth and yttrium ions with propionate, methoxy acetate, and thioglycoate ligands were determined by a potentiometric method at 20°C and an ionic strength of 0.10. The supporting electrolyte was sodium perchlorate. The data indicate that methoxyacetate and thioglycolate (α-mercaptoacetate) ligands behave essentially as monodentate ligands, as do acetate and propionate. It is apparent that the affinity of the simple carboxylic acid ligands for rare earth ions decreases in the order acetate > propionate > isobutyrate. It is also clear that the order of the electron-donating ability of the functional groups studied is OH ≫ OCH_3 > SH. The ionization constants of propionic, methoxyacetic, and thioglycolic acids were determined at 20°C and an ionic strength of 0.10. (auth)

17860 ISOTOPIC EFFECTS DURING CATALYTIC HYDROGENATION. E. D. Bitner, E. Selke, W. K. Roh-

wedder, and H. J. Dutton (Northern Regional Research Lab., Peoria, Ill.). J. Am. Oil Chemists' Soc., 41: 1-3 (Jan. 1964).

The validity of tracer experiments, particularly for the isotopes of H, depends on a knowledge of the magnitude of the isotopic discrimination. The isotopic effect on rate constants for H over T is a factor of 60 and, for H over D, 18. Attempts were made to estimate the magnitude of isotope effects involving T and D by measurement of the isotopic discrimination of T and D during catalytic hydrogenation of methyl oleate with a mixture of H and T and with a mixture of H, D, and T. The catalytic hydrogenation of a T-labeled compound, methyl 9-octadecenoate-9, 10-T, and the description of various specialized equipment and methods of analyses are included. No isotopic discrimination was observed during catalytic reduction of methyl oleate with H–T gas mixtures. One explanation offered is that at atmospheric pressure and 40°C the isotopic effect on solubility is small and the concentration of the dissolved H isotopes is rate limiting. Tritium in methyl 9-octadecenoate-9, 10-T was not released during saturation of the double bond but appears in the gaseous phase upon completion of hydrogenation, as indicated by an ion chamber. No isotopic discrimination was observed in the reduction of methyl oleate with mixtures of H, D, and T; however, mass spectrometry indicated an increase in the H–D ratio during hydrogenation. Under the conditions described, T and D may be used to study the mechanism of hydrogenation without significant isotopic effects. An automatic manometric apparatus used to perform all hydrogenations is illustrated. (BBB)

17861 INTERACTION BETWEEN NUCLEAR SPINS AT LARGE DISTANCE. E. Duval and S. Koide (Université, Geneva). Phys. Letters, 8: 314-15(Mar. 1, 1964). (In French)

The constants of interaction ($^{31}P-{}^{1}H$) in triethyl phosphate and triethyl phosphite were previously determined. An interpretation in terms of two mechanisms producing parallel and antiparallel coupling between the spins of the electron associated with the protons is presented. Generalization is made to the case in which the two interacting nuclei are separated by several atoms. (D.C.W.)

Radiation Chemistry and Radiochemistry

17862 (CEA-Bib-38) METHODES DE DETECTION ET DE MESURE DU TRITIUM ET DE SES COMPOSES. (Techniques for the Detection and Measurement of Tritium and its Compounds). M. Le Pape (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1963. 68p.

References (128) are given on the detection and measurement of tritium and its compounds using scintillation detectors, ionization counters, Geiger-Mueller tubes, proportional detectors, and nuclear emulsions. All references are to work published between October 1961 and August 1963. An author index is included. (P.C.H.)

17863 (EUR-524.n) STANDAARDISATIE VAN COBALT-58. (Standardization of Cobalt-58). R. Vaninbroukx and G. Grosse (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy and European Atomic Energy Community. Central Nuclear Measurements Bureau, Geel, Belgium). 1964. 19p.

A relative method for measuring ^{58}Co with 1% accuracy is described in detail. Use is made of a γ spectrometer that is calibrated, in function of the γ energy, by different sources standardized with high precision in a 4π β-γ coincidence counter. (auth)

17864 (JINR-P-1518) ORIENTATSIYA PROTONOV I MAGNITNAYA RELAKSATSIYA V OBLUCHENNYKH POLIETILENAKH. (Proton Orientation and Magnetic Relaxation in Irradiated Polyethylene). A. V. Kessenikh, V. I. Lushchikov, A. A. Manenkov, and Yu. V. Taran (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Neutron Physics). 1964. 18p.

The dynamical proton polarization and the magnetic relaxation of protons and unpaired electrons in polyethylene irradiated in the nuclear reactor have been investigated. The measurements were made at the temperatures 1.6°K, 4.2°K, and 77°K. The dynamical enhancement factor of the proton polarization does not depend on the sample temperature and varies from 20 to 34 for different samples. The distance between the maximum values for the negative and positive enhancement factor (as a function of the magnetic field) becomes greater with the decrease in temperature which is accounted for by the effect of electron spin-spin cross relaxation. It is shown that the dynamical polarization in the samples under investigation is due to the saturation of the electron paramagnetic resonance of the long-lived radicals of the $(CH_2-CH-(CH=CH)_n-CH_2)$ type. The results are discussed and compared with the phenomenological theory of the dynamical polarization and nuclear magnetic relaxation. (auth)

17865 (NP-13764) SELECTED SYNTHESIS BY FISSION FRAGMENT RECOIL. Quarterly Progress Report No. 2, October 1–December 31, 1963. (Aerojet-General Nucleonics, San Ramon, Calif.). Jan. 1964. Contract AF04 (611)-9069. 24p. (AN-1119)

Attempts to synthesize two high-energy, liquid oxidizers, (A and B) by fission fragment radiolysis are discussed. Calibration of the fuel-capsule system was completed. Four irradiations to synthesize Compound A were made, but analysis of the irradiation products was delayed because of the reaction of NOF and NO_2F with the analytical equipment. Methods of analysis to identify the irradiation products are being developed. Analysis of purified reactant gases showed: a measurable amount of air is not introduced during capsule loading and gas sampling; purification of gases supplied by vendors reduces impurities to acceptable levels; and results of analyses by different techniques closely agree. (P.C.H.)

17866 (NYO-2766) RADIOCHEMICAL EXCHANGE SYSTEMS AND STUDY OF CLATHRATE COMPOUNDS. Annual Report No. 3. (Tracerlab, Inc., Waltham, Mass.). May 1, 1962. Contract AT(30-1)-2204. 102p.

A study is made of the response of Cl_2, F_2, NO, NO_2, freon-12, NH_3, SO_2, and water with a ^{85}Kr clathrate. A batch analyzer utilizing the clathrate double release system is described, and the criterion of a universal gas monitor is considered. A ^{85}Kr clathrate of Dianin's compound (4-p-hydroxyphenyl-2.2.4-trimethylchroman) was prepared and its leakage properties and reactivity with various gases determined. A study is made of absorption isotherms of Cl_2 and F_2 on a quinol clathrate. The leakage of ^{85}Kr is determined as a function of the crystal size, temperature, and surface moisture content of quinol clathrate. A new method of preparing ^{85}Kr clathrate activated light sources is described. (auth)

17867 (SGAE-BL-1/1964) STRAHLENCHEMISCHE UNTERSUCHUNGEN AN HEFENUKLEINSAUREN. (Radiochemical Study on Nucleic Acid of Yeast). K. Kaindl and

H. Altmann (Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf, Austria). [1963]. 8p.

Trace elements form certain resistance factors against environmental influences, which are essentially genetically fixed. Trace elements in nucleic acids might be identified as carriers of the hereditary factor. The concentration of trace elements in nucleic acids is very small and amounts to about 10 to 10^3 ppm; therefore about 10^{-1} to 10 metal ions per 1000 nucleotides are present. The change of the trace-element contents of nucleic acids in yeasts induced by radiation was studied. Trace elements were split by irradiation and the disintegration was furthered by nucleases. The nucleic acids were found to be unstabilized by the loss of the trace elements and this was exhibited as a primary radiation effect. (tr-auth)

17868 (UCRL-11046(p.216-25)) SOME ASPECTS OF THE RADIATION CHEMISTRY OF DNA. Samuel Schrage and Richard M. Lemmon (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry).

Samples of solid DNA (about 0.1 mg) or DNA solution (50 to 200 μl; concentration range 0.01% to 0.4%) were placed in 6-mm OD glass tubes that were then evacuated, sealed, and irradiated with Co^{60} γ rays at a rate of approximately 10^6 rads/hr. Before freezing the solutions and evacuating the tubes, N_2 was bubbled through the solutions for about 10 min to remove dissolved O_2. Irradiated samples and unirradiated controls were hydrolyzed by adding, to the opened irradiation tubes, 20 μl of 70% $HClO_4$ to the solid or to the residue left after evaporating the solution under vacuum. After the addition of the $HClO_4$, the tubes were kept in a steam bath for about 40 min. Their contents were then diluted with 10 to 25 μl of distilled water, and aliquots of appropriate activity were withdrawn and spotted on oxalic-acid washed sheets of Whatman No. 4 paper. After assay of the activity of the applied spot by GM counter, the sheets were subjected to descending chromatography, with n-propanol–16 N NH_4OH–water (6:3:1 by vol) in the first and n-butanol–propionic acid–water in the second dimension. Autoradiographs were prepared by exposing x-ray films to the chromatograms. The identity of a labeled spot was determined by elution of the corresponding area of the chromatogram and subsequent cochromatography with a sample of the uv-absorbing unlabeled compound with which it was supposed to be identical. Coincidence in position of the ultraviolet-absorbing area and the radioactive area confirmed the suspected identity. The fraction of a decomposition product was assayed by counting of the corresponding area of the chromatogram and comparison with the initial count at the origin of the chromatogram. In particular, the fraction of labeled material remaining at the origin was found by comparing the activity at the origin before and after chromatography. The experimental results in the dose range of 10^5 to 10^7 rads did not show any readily observable decomposition products of DNA that could be ascribed to the effects of radiation. Autoradiographs of chromatograms of irradiated solid DNA and irradiated DNA solutions were essentially similar. This somewhat unexpected finding raised questions about the possible effect of water molecules present in solid DNA. DNA contains about 20% water at a relative humidity of 50%. Care was taken in the preparation of several samples dried at room temperature in a vacuum of 10^{-3} mm for 24 hr. The chromatographic analysis after irradiation showed that no differences could be found between these samples and others that had been kept over water for several hours. (auth)

17869 (UJV-976/63) EFFECTS OF IONIZING RADIATION ON EXTRACTANTS—KETONES. PART IV. SOME ASPECTS OF RADIATION CHEMISTRY OF CONCENTRATED AQUEOUS SOLUTIONS. J. Bednář (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). 1963. 16p.

The mechanism of the radiolysis of concentrated aqueous solutions of $NaNO_3$ is suggested, which is appreciably different from the radiolysis of diluted solutions. It is supposed that in the primary stage hydrated nitrate ions are decomposed giving ionized and neutral products of radiolysis. (auth)

17870 CALCULATION OF CONCENTRATION RESPONSE TO INTERMITTENT IRRADIATION. F. B. Hill (Brookhaven National Lab., Upton, N. Y.). A.I.Ch.E. (Am. Inst. Chem. Engrs.) J., 10: 166-73(Mar. 1964).

Methods of formulation of the transient as well as the steady state problem are given. The formulation methods are presented through illustrations. First a system is treated in which a species produced by irradiation disappears via a first-order reaction. This system is treated in some detail for a number of irradiator types, a batch irradiator, a continuous stirred tank irradiator, and a continuous tubular reactor with recycle, and illustrative solutions are obtained. Then the treatment for the batch irradiator is applied to two other kinetic schemes including first a series of consecutive first-order reactions and finally second-order reaction of the intermediate species. (P.C.H.)

17871 THE MÖSSBAUER EFFECT AND ITS SIGNIFICANCE IN CHEMISTRY. E. Fluck, W. Kerler, and W. Neuwirth (Universität, Heidelberg). Angew. Chem. Intern. Ed. Engl., 2: 277-87(June 1963).

Resonance fluorescence of recoil-free γ-rays from atomic nuclei depends on the state of the chemical bonding of the atoms. The latter influences the position of the energy level of the atomic nuclei, so that the energy required for excitation of resonance fluorescence is somewhat smaller or greater than the energy of the γ-quanta emitted by the radiation source. In order to obtain resonance fluorescence, therefore, the radiation source and absorber have to be kept moving relative to each other. If the intensity of the resonance fluorescence is plotted against this relative velocity, Mössbauer spectra are obtained. The positions of the lines in these spectra make it possible to draw conclusions about the nature of the atom's bonds. The efficiency of this method is demonstrated by illustration with numerous iron compounds. It is shown, for instance, that the iron atoms in insoluble Prussian Blue have well-defined oxidation levels. Turnbull's Blue shows the identical spectrum. A structure could be ascribed to triiron dodecacarbonyl that also explains the diamagnetism of the compound. (auth)

17872 DISSOCIATION OF n-PROPANOL MOLECULE IONS FORMED IN CHARGE EXCHANGE COLLISIONS WITH POSITIVE IONS. E. Pettersson (Royal Inst. of Tech., Stockholm). Arkiv Fysik, 26: 181-90(1964).

Mass spectra of n-propanol were obtained after charge exchange with slow positive ions. The intensities of the peaks were plotted as a function of the energy absorbed by the molecule during the charge exchange. Integration of these curves gives a mass spectrum in good agreement with that obtained in electron impact. Ion–molecule reactions were observed at low velocity of the incident ions. (auth)

17873 PURIFICATION OF HIGH SPECIFIC ACTIVITY ACETIC-H^3 ANHYDRIDE. Herbert H. Henderson, Frank

Crowley, and Leo E. Gaudette (NEN Biomedical Assay Labs., Inc.). Atomlight, No. 37: 1-4(Apr. 1964).

Studies were made on the rate of buildup of impurities in benzene solutions of acetic-^{3}H anhydride and removal of impurities. It was found possible to minimize the presence of impurities by distilling the acetic-^{3}H anhydride solution at intervals. The nonvolatile residue in the acetic-^{3}H anhydride is immediately reduced tenfold, and the blank activity on paper chromatograms is essentially background at the end of two chromatographic separations. The purification method is described. (P.C.H.)

17874 THE RADIATION STABILITY OF ANTHRACENE OILS. PART I. RADIOLYSIS IN THE RADIATION FIELD OF A NUCLEAR REACTOR AT TEMPERATURES OF 40–80°C. E. Proksch and H. Bildstein (Osterreichische Studiegensellschaft fur Atomenergie GmbH, Seibersdorf, Austria). Atompraxis, 10: 105-9(Feb. 1964). (In German)

The radiolytic decomposition of different and differently pretreated Anthracene Oils in the radiation field of a nuclear reactor was studied. Untreated samples show initial decomposition rates (G-values) about five times as high as Terphenyls under the same conditions. With increasing radiation doses the G-values slowly decrease to values still higher than those of the Terphenyls. Raffination or an adsorption treatment causes a similar increase in stability. (auth)

17875 THE GAMMA RAY-INDUCED ADDITION OF ACETALDEHYDE TO CYCLOHEXENE AND NORMAL HEXENE. Motoyoshi Hatada, Jun'ichi Takezaki, and Kozo Hirota (Japanese Assn. for Radiation Research on Polymers, Osaka and Osaka Univ.). Bull. Chem. Soc. Japan, 37: 166-70(Feb. 1964).

By the radioinduced telomerization of acetaldehyde-hexene mixtures, methyl cyclohexyl ketone (McHK) was produced when cyclohexene was used, while methyl hexyl ketone (MnHK) and methyl isohexyl ketone (MiHK) were produced when normal hexene was used. The G(MnHK) at room temperature was found to be 400 (dose rate = 9.7×10^4 r/hr), which is larger by a factor of ten than the G(MiHK) and the G(McHK). Irrespective of the dose rate, a G(MnHK) > G(McHK) > G(MiHK) relation always exists. It was found that: the G(MnHK) value, as well as the G(MiHK) and the G(McHK) values, increases with the rise in temperature, they all show however, maxima at 70 ~ 80°C, because of the thermal decomposition of the acetyl radical; sharp maxima are shown in the curves of G(telomer) vs initial composition at 5 mole % of hexenes; the analytical data of the gaseous products establish that the radioinduced decomposition of aldehyde and hexene occurs in parallel with the telomerization; and upon the addition of benzene or cyclohexane to the system, the G(telomer)'s decrease slightly in both systems, suggesting that they act as diluents rather than as agents of the energy transfer. (auth)

17876 THE THERMAL AND RADIATION OXIDATION OF BENZENE TO PHENOL IN AQUEOUS SOLUTIONS CONTAINING METAL IONS AT ELEVATED TEMPERATURES. IV. THE EFFECT OF IMPURITIES IN BENZENE. Nobutake Suzuki and Hiroshi Hotta (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 37: 244-8 (Feb. 1964).

The yield of phenol from the oxidation of unpurified benzene catalyzed by metal ions in an aqueous solution was much larger than from that of purified benzene. Phenol was produced in a good yield at temperatures lower than 160°C only in an oxygenated solution, in which OH radicals were produced, either with or without irradiation. Therefore, the autoxidation of impurities in benzene, initiated by OH radicals, is the initiation reaction of the chain oxidation process. On the other hand, phenol was also produced above 180°C even when OH radicals were not produced. Therefore, it is considered that the hydroperoxides of impurities are formed at higher temperatures without the OH radical by means of their autoxidation. Moreover, the yield of phenol in a cupric sulfate solution decreases remarkably with an increase in the sulfate concentration. (auth)

17877 EFFECTS OF GAMMA RADIATION ON POLYMERS IN SOLUTIONS. VII. EFFECTS OF DEGREE OF POLYMERIZATION ON CROSSLINKING OF POLY(VINYL ALCOHOL) IN AQUEOUS SOLUTIONS. Ichiro Sakurada and Yoshito Ikada (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 42: 22-31(Jan. 1964).

Dilute aqueous solutions of poly(vinyl alcohol) having various degrees of polymerization from 60 to 19700 were exposed to gamma radiation in the absence of air and the crosslinking mechanism was examined in detail. It was found from the results that the critical concentration for gel-formation C_{crit} can be written by the equation: $C_{crit}[\eta]^{0.62} = \text{const.}$ where $[\eta]$ is the limiting viscosity number of unirradiated samples. The assumption that at the critical concentration the polymer spheres just begin to overlap with each other and array in the order of closed packing could give a satisfactory account of the experimental results. Namely, the radius of polymer sphere calculated on the basis of the above assumption was almost proportional to the hydrodynamic effective radius calculated from the Einstein formula and radius of gyration. The rapid rise of gelation dose usually observed near the critical concentration may be due to slight change in the degree of overlapping of polymer coils. The gelation dose at a fixed concentration was inversely proportional to the degree of polymerization of samples used. G-value for crosslinking was found to be 6.2. The indirect effect via water was quantitatively discussed and it was found that only 5.5% of radiation energy absorbed directly by water was actually dissipated for the formation of crosslinking. (auth)

17878 EFFECTS OF GAMMA RADIATION ON POLYMERS IN SOLUTIONS. VIII. RADIATION EFFECTS ON POLY(VINYL ALCOHOL) IN AQUEOUS SOLUTIONS BELOW CRITICAL CONCENTRATION FOR GEL-FORMATIONS. Ichiro Sakurada and Yoshito Ikada (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 42: 32-41(Jan. 1964).

Aqueous solutions of poly(vinyl alcohol) were irradiated in the absence of air with Co-60 γ rays at very low concentrations such as 0.184, 0.100, and 0.06%. (The critical concentration for gel-formation of this solution was 0.22%). It was found that at small doses solution viscosity increased, but after reaching a maximum, decreased monotonically with increasing radiation dose. The increase in viscosity was attributed mainly to the formation of intermolecular crosslinking, and the decrease in viscosity mainly to the intramolecular crosslinking. The evidence for the formation of the intramolecular crosslinking was obtained by various measurements such as turbidity, acetylation, swelling and x-ray diffractions. Infrared spectra of the irradiated PVA indicated that the OH groups of PVA disappeared partly during irradiation, while slight formation of carbonyl group was observed. The number of intramolecular crosslinks was calculated using Flory-Rehner's and Einstein's equations. (auth)

17879 RADIOTHERMOLUMINESCENCE OF ANTHRACENE–TETRACENE MIXED CRYSTAL. Naoko Shiomi, Keiichi Imakubo, Takenobu Higashimura, and Tunahiko

Sidei (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 42: 54-5(Jan. 1964).

The radiothermoluminescence glow curves of various anthracene–tetracene mixed crystals which included six sorts of tetracene contents, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7}, and 0 grams of tetracene/grams of anthracene (gr/gr) were observed for various radiation doses in the temperature range 77 to 273°K. It was found that both of the glow intensities and the saturation doses becomes larger as the tetracene content becomes larger. Numerically, the crystal of tetracene contents, 10^{-3} and 10^{-6} (gr/gr) shows saturation doses of glow intensities at 10^{6} r and 10^{3} r, respectively. It was concluded that the tetracene molecule acts as a trap of electrons that are emitted by the irradiation. (auth)

17880 GAMMA-RAY INDUCED GRAFT COPOLYMERIZATION. IX. EFFECTS OF SOLVENTS ON THE SOLUTION GRAFT COPOLYMERIZATION OF STYRENE ONTO CELLULOSE ACETATE BY A PREIRRADIATION TECHNIQUE. Kiyoshi Hayakawa and Kaoru Kawase (Government Industrial Research Inst., Nagoya, Japan). Chem. High Polymers (Tokyo), 20: 609-13(Oct. 1963). (In Japanese)

The γ-ray-induced graft copolymerization of styrene on cellulose acetate fiber by a pre-irradiation technique in air was studied in the presence of various solvents, mainly from the viewpoint of the chain transfer. Aromatic hydrocarbon solvents with larger side chains decreased the degree of polymerization of the grafted polystyrene and percentage of grafting markedly, and a remarkable effect was observed by the addition of carbon tetrachloride. By assuming that the process of chain transfer in homogeneous systems is applicable to this heterogeneous reaction, the transfer constants for solvents and an activation energy were calculated from the degree of polymerization of graft polystyrene and the amount of grafting. The coincidence of the calculated values with those already reported for homogeneous polymerization of styrene was almost satisfactory. (from NSA of Japan)

17881 RADIATION INDUCED POLYMERIZATION OF METHACRYLIC ACID IN SOLUTION. Tatsuo Matsuda and Hiromi Yamakita (Government Industrial Research Inst., Nagoya, Japan). Chem. High Polymers (Tokyo), 20: 614-18(Oct. 1963). (In Japanese)

In the polymerization of methacrylic acid in methanol solution, the rate of polymerization decreased as the polymerization temperature decreased in the range from −78 to +30°C. An apparent activation energy was calculated to be 3.6 kcal/mol. The rate of polymerization was proportional to 0.47 power of dose rate. Benzoquinone inhibited the polymerization. These results indicate that the polymerization proceeds by a free radical mechanism. The infrared spectrum and x-ray-diffraction diagram of polymethyl methacrylate prepared from esterification of polymethacrylic acid indicated that a syndyotactic polymer was obtained by low temperature polymerization. In the polymerization in methanol solution, the syndyotacticity increased as the polymerization temperature decreased, and $(E_S - E_I)$, the difference of activation energy between syndyotactic and isotactic propagation, was calculated to be −0.5 kcal/mol. It was also found that the system-precipitating polymers reduced the syndyotacticity. (from NSA of Japan)

17882 DECOMPOSITION OF NiO BY NEUTRON IRRADIATION. Alain Blaise and Pierre Lefevre (Centre d'Etudes Nucleaires, Grenoble, France). Compt. Rend., 258: 2320-3(Feb. 24, 1964). (In French)

The magnetic susceptibility of NiO was measured before and after irradiation at varying temperatures in a helium atmosphere. Decomposition of the oxide occurred at temperatures ≥250° (threshold for decomposition). The decomposition was greatest at 250°C, the Neel temperature of the oxide. Below 250°C, NiO is rhombohedral; above 250°C, it is cubic. A threshold effect for the integrated neutron flux was also observed. (D.C.W.)

17883 KINETIC STUDY OF THE RADIOCHEMICAL POLYMERIZATION OF ISOPRENE. Andre Hinschberger and Jean Marchal (Centre de Recherches sur les Macromolecules, Strasbourg). Compt. Rend., 258: 2327-30 (Feb. 24, 1964). (In French)

The kinetics of the polymerization of pure and degassed isoprene by gamma radiation was studied between −196 and 40°C. The results can be explained by a superposition of two independent mechanisms of polymerization (monomolecular and bimolecular termination). The mechanism of monomolecular termination is probably cationic, while the bimolecular termination is a radical process. (tr-auth)

17884 THE EFFECT OF PHASE STATE ON THE REACTION OF TRITIUM RECOIL ATOMS IN A MIXTURE OF CYCLOHEXANE AND BENZENE. E. N. Avdonina and An. N. Nesmeyanov (Moscow State Univ.). Dokl. Akad. Nauk, SSSR, 154: 851-3(Feb. 1, 1964). (In Russian)

The most probable products of a "hot" reaction are the formation of HT and a tagged compound. The effect of the liquid phase state on the replacement of a hydrogen atom by a tritium recoil atom was investigated by irradiating 0.02 g of Li_2CO_3 and 0.015 g of organic material in a quartz ampoule with a volume of 0.3 cm^3 for a period of 20 minutes at a neutron flux of 2×10^{12} neutrons cm^{-2} sec^{-1} at temperatures of 40 and −195°C. The gas phase reaction was carried out with 0.008 g of organic material (a binary mixture of benzene and cyclohexane) in a quartz ampoule containing 0.5 g of Li_2CO_3 in a volume of 3.5 cm^3. The gas-phase irradiation required two hours at a neutron flux of 1×10^{12} neutrons cm^{-2} sec^{-1} and a temperature of 150°C. The irradiated samples were analyzed by gas chromatography. The yield of HT decreases and the yield of tagged hydrocarbon increases on going from a gas phase irradiation to a liquid phase irradiation. The radiochemical yield is not a linear function of the concentration of a component. The specific activity of benzene increases sharply on going to a state with a more ordered structure. (TTT)

17885 USE OF ELECTRON PARAMAGNETIC RESONANCE TO SHOW THE PARTICIPATION OF BOUND ELECTRONS IN RADIATION CHEMISTRY REACTIONS IN FROZEN AQUEOUS SOLUTIONS. B. G. Ershov, A. K. Pikaev, P. Ya. Glazunov (Inst. of Physics and Chemistry, Moscow). Dokl. Akad. Nauk SSSR, 154: 899-902(Feb. 1, 1964). (In Russian)

Frozen samples of 1M $NaNO_2$, and 1M and 5M $NaNO_3$ in acid (0.1N), neutral, and alkaline solutions (1 and 5M KOH) were irradiated with 900 kev electrons at temperatures of −196°C to −150°C. The absorbed dose was $1-2 \times 10^{20}$ ev/ml. Electron paramagnetic resonance (EPR) spectra of the acid and neutral solutions irradiated at −196°C show a doublet due to the OH radical which does not exist above −160°C. In alkaline solutions the OH radical is replaced by the more stable ion radical $O^- \cdot nH_2O$. At temperatures of about −160°C the OH radical disappears, and there remain NO_2, NO_3, and in alkaline solution $O^- \cdot nH_2O$, which do not change in concentration to temperatures of −140°C. Nitrite solution spectra from samples irradiated at −150° show two triplets due to the NO_2 radical whose relative intensity depends on the matrix (Ar, CO_2, or CH_4). There are also a

singlet and a triplet due to the NO_2^{2-} radical which increases with the alkalinity of the solution. Nitrate samples similarly show the presence of a NO_3^{2-} radical. The NO_3^- radical disappears by the reactions $NO_3^- + H \rightarrow NO_2 + OH^-$, and $NO_3^- + OH \rightarrow NO_3 + OH^-$. The NO_2^{2-} and NO_3^{2-} radicals are formed by reaction of NO_2^- and NO_3^- respectively with a hydrated electron. (TTT)

17886 THE PREPARATION AND CONTROL OF PRODUCTION OF IODINE-131 AND GOLD-198 IN THE COLLOIDAL STATE. R. Constant (Center for Study of Nuclear Energy, Mol, Belg.). Farmaco (Pavia) Ed. Prat., 17: 3-27 (Jan. 1962). (In French)

The two most important methods for production of ^{131}I are fission and neutron activation. Iodine-131 produced in fission can be recovered by simple distillation from a nitric acid solution of fission products, but the method requires numerous purifications, and is long, arduous, and requires extensive protective measures against the radiation of the fission products associated with the ^{131}I. Neutron irradiation of Te yields ^{131}Te which decays to ^{131}I. This has disadvantages because the Te often is impure and requires extensive purification. Care must be taken to remove any ^{210}Po present, the chemical procedures are extensive, and many purification steps are needed to provide a medically suitable product. Production by simple diffusion is based on the principle of sublimation. Often the dioxide is impure, or the I may be retained because the Te dioxide used becomes calcined. Production of ^{131}I by irradiation of telluric acid has several advantages; high solubility, ease of separation of the ^{131}I, elimination of many steps in distillation and oxidation-reduction cycles, and a high purity product. Production of colloidal radiogold for medical purposes requires a high stability colloid, freedom from toxic substances, a pH greater than 5, absence of particulate matter that could diffuse into tissues, and absence of soluble radioisotope. The starting substance may be Na chloraurate. Gelatin is added as a protector, and chemical reduction is carried out with ascorbic acid or glucose. This method is based on the fact that to obtain a uniform colloid it is necessary to separate the growth phase from the reduced phase. The sizes of the particles obtained by this method are from 40 to 50 Å When a seeding method is used, the particle size is much more uniform. It amounts to ~300 Å. (BBB)

17887 INDUSTRIALIZATION OF IRRADIATION OF POLYETHYLENE AND APPLICATION OF THE PRODUCT. Shotaro Tada (Sumitomo Electric Industry, Ltd., Japan). Genshiryoku Kogyo, 9: No. 9, 21-5(Sept. 1963). (In Japanese)

Polyethylene with radioinduced crosslinking is a useful commercial product with few production problems. Damage from superheating polyethylene with high radiation dose rates may be minimized by many short-time irradiations or the use of an extended electron beam. High dose rates also cause a local accumulation of charge in the polyethylene with the risk of discharge. Therefore, for molded products peroxide crosslinking is recommended. Irradiated polyethylene has many practical applications because of its elevated softening point (100 to 105°C), which is easily attained but sufficiently removed from room temperature. The softened polyethylene has good workability and is suitable for packaging foods. Another advantage of crosslinked polyethylene is its applicability to low-cost inflation molding. (from NSA of Japan)

17888 SULFOCHLORINATION OF CYCLOHEXANE INDUCED BY GAMMA RADIATION. Alfred Schneider and Juchin Chu (Polytechnic Inst. of Brooklyn). Ind. Eng. Chem., Process Design Develop., 3: 164-9(Apr. 1964).

The possibility of utilizing gamma radiation for initiating direct sulfochlorination of hydrocarbons was studied. Liquid cyclohexane reacted with SO_2 and Cl_2 in the presence of gamma radiation to give very high yields of cyclohexanesulfonyl chloride and some chlorocyclohexane and cyclohexanedisulfonyl chloride. Reaction rates were determined as a function of dose rate. The selectivity of the reaction and the degree of conversion were determined as a function of temperature, gamma radiation intensity, and SO_2/Cl_2 ratio. A reaction mechanism was proposed for this chain reaction. A basic plant design was developed for the continuous sulfochlorination of cyclohexane initiated by gamma radiation. (auth)

17889 USE OF GAMMA RADIATION TO PRODUCE WOOD-PLASTIC COMBINATIONS. D. S. Ballantine (Brookhaven National Lab., Upton, N. Y.). Isotopes Radiation Technol., 1: No. 2, 189-95(Winter 1963-64).

Research on improvement of the properties of wood by impregnation with a monomer and polymerization of the resin in situ by means of gamma irradiation is reviewed. All properties studied, i.e., dimensional stability and water absorption, hardness, compressive strength, static bending strength, and shear strength, were improved by impregnation with resin. The chemistry of the polymerization process and the distribution of the polymer in wood were determined. (M.C.G.)

17890 EFFECTS OF GAMMA RADIATION ON THE ELASTIC PROPERTIES OF VITREOUS ARSENIC TRISULFIDE. I. A. Domoryad, D. Kaipnazarov, and L. P. Khiznichenko. Izv. Akad. Nauk Uz. SSR, Ser. Fiz.-Mat. Nauk, No. 5, 87-9(1963). (In Russian)

Radiation effects on the elastic properties of As_2S_3 were studied as a function of gamma dose to 10^8 r. (R.V.J.)

17891 LIGHT STORAGE PROPERTIES OF KCl–Tl, Ca-PHOSPHOR CRYSTALS. V. P. Chernenko, F. N. Zaitov, and Yu. L. Lukantsever (Oshsk State Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 6, 34-6(1963). (In Russian)

A light-storage process in KCl monocrystals (activated by 0.1 mole% Tl and 0.5 mole% Ca) following exposure to strong x radiation was investigated. Luminescence spectra for exposures at 45 and 90 min intervals and for a 20-hr pause were analyzed. (tr-auth)

17892 LUMINESCENCE OF ACTIVATED LiF CRYSTALS. E. P. Alekseeva (Irkutsk State Univ., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 6, 110-16(1963). (In Russian)

Detailed studies were made of luminescence in lithium fluoride monocrystals activated by uranyl, copper, magnesium, and iron salts. Effects of ionizing radiation on luminescence were analyzed. (R.V.J.)

17893 RECOIL TRITIUM REACTIONS: METHYL CHLORIDE. Yi-noo Tang, Edward K. C. Lee, and F. S. Rowland (Univ. of Kansas, Lawrence). J. Am. Chem. Soc., 86: 1280-6(Apr. 5, 1964).

Recoil tritium reactions with CH_3Cl give three important hot products HT, CH_2TCl, and CH_3T, in the approximate ratios 2.7:1.0:0.8 at 1 atmosphere pressure. When I_2 is used as the radical scavenger, CH_2TI is observed in yields comparable to that of CH_2TCl. Variation of the gas pressure during irradiation shows that the yields of CH_2TCl and CH_2TI are pressure dependent in a manner consistent with the reaction $CH_2TCl^* \rightarrow CH_2T + Cl$. Measurements in the liquid phase indicate that approximately half of the

original molecules formed by substitution of T for H decompose at 1 atm. gas pressure before de-excitation can occur. The relative ease of replacement of H by T per C—H bond is about 0.78 to 1 for CH_3Cl vs cyclo-C_4H_8. The pressure-dependent reactions demonstrate the presence of a long-lived excited molecule and indicate that most of the observed CH_2T radicals are formed through a two-step mechanism. Steric inhibition of hot substitution reactions by Cl substituents is a small effect at most. (auth)

17894 PHOTOIONIZATION AND γ-INDUCED OXIDATION OF AROMATIC AMINES IN RIGID ORGANIC GLASSES. M. Kondo, M. R. Ronayne, J. P. Guarino, and W. H. Hamill (Univ. of Notre Dame, Ind.). J. Am. Chem. Soc., 86: 1297-1300(Apr. 5, 1964).

Photoionization of N,N-dimethyl-p-phenylenediamine occurs in polar glasses at 77°K, but not in pure hydrocarbons. Addition of electron-accepting solutes greatly enhances photoionization yields in polar glasses, but only the more easily reduced of these enhance yields in nonpolar glasses. γ Irradiation produces much higher yields of amine cation in nonpolar glasses than in polar glasses. In both types of media yields can be enhanced by addition of electron acceptors, but yields are much smaller in polar glasses. Results of γ irradiation indicate that charge transfer is very largely responsible for amine cation yields. (auth)

17895 GAS PHASE RADIOLYSIS OF PENTABORANE-9. V. V. Subbanna, L. H. Hall, and W. S. Koski (Johns Hopkins Univ., Baltimore). J. Am. Chem. Soc., 86: 1304-6(Apr. 5, 1964).

Mass spectral analysis of the products produced by deuteron irradiation of pentaborane-9 showed that hydrogen, diborane, and decaborane-16 are formed in addition to polymeric materials. As a result of experiments involving the use of deuterium as a tracer, the rare gases as sensitizing agents, and iodine as a scavenging agent, a mechanism is proposed in which it is postulated that BH, which is produced by the radiation fragmentation of B_5H_9 molecules, abstracts hydrogen in stepwise fashion from pentaborane-9, giving BH_3 and B_5H_8 radicals, BH_3 dimerizes to give diborane and two B_5H_8 radicals couple to give decaborane-16. (auth)

17896 γ-RAY DECOMPOSITION OF PURE LIQUID SULFUR DIOXIDE. Walter G. Rothschild (Ford Motor Co., Dearborn, Mich.). J. Am. Chem. Soc., 86: 1307-9 (Apr. 5, 1964).

Pure liquid sulfur dioxide irradiated by Co^{60} γ rays at −17°C disproportionates essentially according to $3SO_2 \rightarrow 2SO_3 + S$. The elemental sulfur precipitates in the shape of long needles. Analyses of the permanent gases by combustion techniques and mass spectrometry indicate that small amounts of molecular oxygen are also formed. The oxygen does not arise by recombination of O atoms in the spurs but, most likely, by the attack of O atoms on sulfur trioxide. The rate of formation of sulfur and sulfur trioxide is constant with dose up to at least 0.5% conversion of SO_2 to SO_3. The rate of formation of oxygen increases with dose. The G-values (100 ev yields) of the production of SO_3, S, and O_2 are 1.31 ± 0.04, 0.65 ± 0.02, and approximately 0.01, respectively. On the basis of a proposed reaction mechanism, which employs the species O and SO, the primary G-value of the decomposition of pure liquid sulfur dioxide is calculated to be 1.35. The ratio of the rate constants of the reaction steps $O + SO_3$ and $O + SO_2$ is estimated to be 10. (auth)

17897 EFFECT OF PRESSURE IN THE RADIOLYSIS AND PHOTOLYSIS OF METHANE. P. Ausloos, R. Gorden, Jr., and S. G. Lias (National Bureau of Standards, Washington, D. C.). J. Chem. Phys., 40: 1854-60(Apr. 1, 1964).

The photolysis and radiolysis of equimolar CH_4-CD_4 mixtures were investigated as a function of pressure. The fact that, in the presence of NO, the ethane fraction consists entirely of C_2D_6, $C_2D_4H_2$, $C_2H_4D_2$, and C_2H_6 in comparable amounts indicates that CH_2 and CD_2 are produced. The relative yield of the ethanes that are formed by insertion of methylene into methane increases with pressure in both the photolysis and radiolysis. In the radiolysis, the G value reaches a value of 0.35 ± 0.1 at pressures above 15 atm. Information about the effect of pressure on the production of the ethyl ion was obtained by investigating the radiolysis of $CH_4-C_4D_{10}$ and $CD_4-C_3H_8$ mixtures from 1.5 cm to 130 atm. The data indicate that there is a gradual decrease of the ethyl ion yield with increase in pressure while the parent ion yield increases with increase in pressure to a pressure of at least 15 atm. (auth)

17898 ABSORPTION BANDS OF IRRADIATED MAGNESIUM FLUORIDE. Marian E. Hills and William R. McBride (Naval Ordnance Test Station, Inyokern (China Lake), Calif.). J. Chem. Phys., 40: 2053-4(Apr. 1, 1964).

Studies were made on the effects of x irradiation on the absorption spectra of magnesium fluoride. The results indicate that at least three absorption bands are formed either in the initial x irradiation or upon optical bleaching of irradiated magnesium fluoride at room temperatures. (P.C.H.)

17899 KINETIC STUDY OF THE RADIOLYSIS OF DILUTE AQUEOUS SOLUTIONS OF BROMINE IN HYDROGEN. C. Ferradini and A. M. Koulkes-Pujo (Faculte des Sciences, Paris). J. Chim. Phys., 60: 1310-14(Nov.-Dec. 1963). (In French)

Some H_2SO_4 solutions (0.8N or pH 2.2) containing H_2 and Br^- were subjected to gamma irradiation under H_2 pressures between 1 and 20 atmospheres to determine the effect of Br^- on H_2O_2 production from H_2+OH. The initial yield of H_2O_2 was measured as a function of Br^-/H_2, and the ratio of the formation constants of $H_2 + OH \rightarrow H + H_2O$ and $Br^- + OH \rightarrow Br + OH^-$ was obtained. The effect of pH on this ratio was also determined. A kinetic interpretation of the results is suggested. (D.C.W.)

17900 FREE RADICALS PRODUCED IN GAMMA IRRADIATION OF CELLULOSE: APPLICATION TO GRAFTING. Olivier R. Bernard, Didier Gagnaire, and Pierre Servoz-Gavin (Centre d'Etudes Nucleaires, Grenoble, France). J. Chim. Phys., 60: 1348-54(Nov.-Dec. 1963). (In French)

The structures of radicals produced in gamma irradiation of cellulose and of those present during or after copolymerization of styrene on cellulose was studied by the electron paramagnetic resonance (EPR) technique. Irradiation grafting of the polymer before or during contact with the monomer was used. The radicals produced were separated into two classes. The radicals of each class have practically symmetric EPR spectra. Only one class of radicals intervenes in the grafting of styrene on cellulose. (D.C.W.)

17901 THE SYNTHESIS OF HIGHLY ORIENTED POLYTHIOMETHYLENE DIRECTLY BY THE RADIATION POLYMERIZATION OF CRYSTALLINE TRITHIANE. J. B. Lando and V. Stannett (Research Triangle Inst., Durham, N. C.). J. Polymer Sci., Pt. B, 2: 375-8(Apr. 1964).

Experimental conditions are reported for the successful radiation polymerization of crystalline trithiane to yield highly oriented polythiomethylene. It is noted that the sharp orientation spots of polythiomethylene form definite layer lines corresponding to a spacing along the axis of orientation of the polymer of 5.10 A, quite close to the spacing of trithiane in this direction of 5.25 A. An analysis of the x-ray reflections of polythiomethylene, distinguishable from those of trithiane indicates a possible orthorhombic space group for the polymer with a = 12.7, b = 12.0, and c = 5.10 A. A list of the polymer reflections and their Miller indexes, assuming the orthorhombic unit cell is given. (P.C.H.)

17902 EFFECTS OF NUCLEAR RADIATION ON CATALYTIC PROPERTIES OF NICKEL OXIDES. I. Maksim, T. Braun, and G. Glants (Inst. of Physics, Bucharest). Kinetika i Kataliz, 5: 90-5(Jan.-Feb. 1964). (In Russian)

Radiation defects produced by 2000-kw BBR-C reactor radiation on NiO + 2.5 mole % Li_2O increased the catalytic activity and electric conductivity of the material. Temporary defects produced by radiation at 300 to 400° do not affect the catalytic activity. At room temperature the temporary defects improve the conductivity. Permanent defects reduce the activation energy for the oxidation of CO by oxygen. (R.V.J.)

17903 KINETICS OF RECOMBINATION OF CYCLOHEXYL RADICALS IN IRRADIATED CYCLOHEXANE. N. Ya. Buben, A. I. Pristupa, and V. N. Shamshev (Inst. of Chemical Physics, Academy of Sciences, USSR). Kinetika i Kataliz, 5: 190-1(Jan.-Feb. 1964). (In Russian)

Kinetics of recombination of radicals formed during the irradiation of cyclohexane were studied. It was shown that at 186°K the irradiated radicals recombine about 1 sec after the electron beam is cut off. The function log K = f(1/T) at 188 to 236°K was used for determining the activation energy E = 8.0± 0.5 kcal/mole and the magnitude of the multiplier $K_0 = 3 \times 10^{-8}$ cm^3/sec for determining recombination of cyclohexyl radicals. The absolute magnitude of k_0 was determined with an order of accuracy of ~100%. The magnitude of the constant at T = 181°K (when recombination was slow and could be measured 15 min after exposure) was $K = 10^{-22}$ cm^3/sec. The transition through T_p was followed by reduced recombination energy of radicals (from 20 to 8 kcal/mole) and a sharp rise of the recombination rate (10^5 times as high for a 7° temperature rise). The results of experiments showed that the fast recombination at the polymorphous transformation point was not related to the reconstruction of the molecular lattice but was a result of release in the radical diffusion in the gaso-crystalline state of cyclo-hexane. (R.V.J.)

17904 FEASIBILITY STUDY OF ION-EXCHANGE MEMBRANES PRODUCED BY RADIO-CHEMICAL GRAFT-COPOLYMERIZATION. E. Sporkenbach, H. Langner, and L. Wuckel (Inst. of the Applied Physics of Pure Substances, German Academy of Sciences, Dresden). Monatsber. Deut. Akad. Wiss. Berlin, 6: 57-9(1964).

Experiments leading to the production of strongly acidic cation-exchange membranes are reported. The method studied was that of grafting polyethylene foils with styrene and simultaneous irradiation with Co-60 gamma rays followed by sulfonization with chloro-sulfonic acid. Various methods of irradiation grafting were investigated in order to determine the optimum conditions for membrane formation. Preirradiation in air at high intensity and of short duration appears to be the most practical procedure. (OTS)

17905 RADIATION-INDUCED FORMATION OF THE UNIVALENT Mg^+, Zn^+, AND Cd^+ FROM THE DIVALENT CATIONS IN γ-IRRADIATED ICE. P. N. Moorthy and J. J. Weiss (Durham Univ., Eng.). Nature, 201: 1317-18 (Mar. 28, 1964).

Radiolysis experiments with $MgSO_4$, $ZnSO_4$, $CdSO_4$ in an ice matrix are reported. The metal cations Mg^{2+}, Zn^{2+}, and Cd^{2+} were observed to form lower oxidation states that are normally unstable. ESR spectra were used to identify the univalent cations. (C.E.S.)

17906 RADIATION-INDUCED CHAIN OXIDATION OF PHOSPHORUS(III), ARSENIC(III) AND ANTIMONY(III) IN THE PRESENCE OF IRON(II) IN AERATED 0.8 N SULFURIC ACID. Niro Matsuura (Tokyo Univ.), Yoshimi Kurimura, and Masao Takizawa. Nippon Kagaku Zasshi, 85: 96-102(Feb. 1964). (In Japanese)

A radiation chemical study was made on three binary mixtures of $P^{(III)}$ and $Fe^{(II)}$, $As^{(III)}$ and $Fe^{(II)}$, and $Sb^{(III)}$ and $Fe^{(II)}$ in aerated 0.8 N sulfuric acid solutions. The irradiation was carried out at ca 20°C by ^{60}Co γ rays at a dose rate ranging from 2.0×10^{16} to 2.2×10^{16} ev · ml^{-1} · min^{-1}. Oxidation of large quantities of two different ions, $S^{(III)}$($P^{(III)}$, $As^{(III)}$, or $Sb^{(III)}$) and $Fe^{(II)}$ took place in the solution under irradiation, e.g., $G[As^{(V)}] = 150$ and $G[Fe^{(III)}] = 300$ for the system of 2.0×10^{-4} M of $As^{(III)}$ and 1.0×10^{-4} M of $Fe^{(II)}$. The oxidation yield dependence on the concentrations of $S^{(III)}$ and $Fe^{(II)}$ was found to be complicated. In general, the decrease in yields of $Fe^{(III)}$ and $S^{(V)}$, and the increase in ratio of $Fe^{(III)}$ yield to $S^{(V)}$ yield were caused by the increase in the ratio of $Fe^{(II)}$ concentration to $S^{(III)}$ concentration. Post-irradiation effects due to H_2O_2 formed were observed for the systems of $As^{(III)}$–$Fe^{(II)}$ and $Sb^{(III)}$–$Fe^{(II)}$, but not for the $P^{(III)}$–$Fe^{(II)}$ system. Large values of the oxidation yields indicate the presence of a chain reaction. The reaction chains are: $S^{(III)} + OH = S^{(IV)} + OH^-$, $S^{(IV)} + O_2 + H^+ = S^{(V)} + HO_2$, $Fe^{(II)} + HO_2 + H^+ = Fe^{(III)} + H_2O_2$, $Fe^{(II)} + H_2O_2 = Fe^{(III)} + OH^- + OH$. It is assumed that $S^{(IV)}$ is easily oxidized by O_2 to $S^{(V)}$ with HO_2 formation in the presence of $Fe^{(II)}$. The termination occurs by the reactions: $Fe^{(II)} + OH = Fe^{(III)} + OH^-$, and $S^{(IV)} + S^{(IV)} = S^{(III)} + S^{(V)}$. From the yields obtained and the mechanism proposed, the following values were obtained: $k_{As^{(III)} - OH}/k_{Fe^{(II)} - OH} = 30$, and $k_{Sb^{(III)} - OH}/k_{Fe^{(II)} - OH} = 5$. (auth)

17907 INFRARED QUANTUM COUNTER ACTION IN Er-DOPED FLUORIDE LATTICES. M. R. Brown (Ministry of Aviation, Signals Research and Development Establishment, Christchurch, Hampshire, Eng.) and W. A. Shand. Phys. Rev. Letters, 12: 367-9(Mar. 30, 1964).

The action in Er^{3+} doped 1% in LaF_3, SrF_2, CaF_2, and BaF_2 at room temperatures is reported. The pump and signal radiations were in the near infrared, while the fluorescent output from combined schemes was in the visible. Two infrared quantum counter schemes giving a red fluorescent output and three giving a red and green fluorescent output were identified. A photograph showing the band of fisible fluorescence produced by focusing infrared radiation from a xenon lamp into the Er^{3+} doped SrF_2 crystal is shown, and the variation with the host lattice is explained. (L.B.S.)

17908 TRAPPING LEVELS AND THERMOLUMINESCENCE OF CsI DOPED WITH VARIOUS ACTIVATORS. Prudencio Martinez, Frank E. Senftle, and Marlys Page (Geological Survey, Washington, D. C.). Phys. Rev. Letters, 12: 369-72(Mar. 30, 1964).

Thermoluminescence curves of pure cesium iodide and cesium iodide crystals doped with silver, indium, copper, and thallium activated with 58-kv, 6-ma x rays

at 77°K are shown. The occurrence of the main peaks at the same temperature in all the crystals indicates that the main trapping levels are characteristic of the host lattice, regardless of the type of activation. It is hypothesized from experimental results that the first major peak is associated with the thermal release of a self-trapped hole, while the second major peak is associated with a hole-type center. (L.B.S.)

17909 AN INVESTIGATION OF TRANSMUTATION EFFECTS IN CRYSTALLINE SOLIDS. M. C. Wittels, J. O. Stiegler, and F. A. Sherrill (Oak Ridge National Lab., Tenn.). Phys. Status Solidi, 4: 533-55(1964).

X-ray diffraction, electron diffraction, microscopy, metallography, and thermal methods were utilized to study transmutation effects in a group of crystalline solids. Nearly homogeneous distributions of transmuted species were introduced into small single crystals of ^{197}Au, ^{107}Ag, and ^{115}In, and powder samples of ^{193}Ir, $^{115}In_2O_3$, and $^{176}Lu_2O_3$. The crystals were irradiated in a thermal neutron flux of 4.0×10^{14} neutrons/cm^2 sec at a temperature of ~85°C for periods of a few days to several months so that considerable fractions of transmuted species were formed. Small metal-single-crystal spheres were converted to alloy single crystals in their solid solution ranges at temperatures up to several hundred degrees below those required by normal laboratory methods in $Au_{0.82}Hg_{0.18}$, $Ag_{0.78}Cd_{0.22}$, and $In_{0.95}Sn_{0.05}$. A powder sample of ^{193}Ir was transformed into the solid solution alloy $Ir_{0.68}Pt_{0.32}$, a high-temperature alloy, which would require a temperature in excess of 2000°C for its formation by laboratory methods. The production of 22.5 at. % ^{198}Hg and ^{199}Hg in ^{197}Au through nuclear transmutation revealed the nucleation of Au_3Hg particles with the hcp structure, while the introduction of 29 at. % caused a recrystallization into two unidentified phases. Long range order in single crystals of ^{115}In was completely destroyed when 14 at. % ^{116}Sn was introduced through nuclear transmutation. Powder specimens of In_2O_3 enriched in ^{115}In were irradiated to produce concentrations of ^{116}Sn as high as 38 at. % with the result that a new phase with a smaller fluorite structure was formed which contained oxygen vacancies. The original In_2O_3 structure was largely recovered upon annealing at 1200°C and SnO_2 particles were precipitated. Powder samples of Lu_2O_3 containing ^{176}Lu were irradiated to produce 74 at. % ^{177}Hf and the resultant material was cubic (fluorite) with a lattice parameter approximately one-half that of the original structure. This oxygen deficient lattice was stable at temperatures up to 120°C. The results are considered in terms of the original crystal structures and known phase equilibrium systems. (auth)

17910 POSITIVE TEMPERATURE COEFFICIENTS OF THE LUMINESCENCE AND THE CONDUCTIVITY OF ZnS SINGLE CRYSTALS AFTER EXCITATION WITH 60-kev ELECTRONS. W. Klein (Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin). Phys. Status Solidi, 4: 605-29(1964). (In German)

Measurements were made of the temperature dependence of the emission bands and conductivity of ZnS single crystals, which were irradiated with 60-kev electrons. The positive temperature coefficients of the luminescence and conductivity are emphasized. A quantitative theoretical investigation showed that both the positive temperature coefficients and the shift of the temperature maximum of luminescence, with increasing excitation densities, to higher temperatures can be explained by the Riehl-Schön model. The depth of the traps below the conduction band can be deduced from the positive temperature coefficient, and the results are in good agreement with those of glow measurements. (auth)

17911 PRODUCTION OF POLYFORMALDEHYDE BY RADIATION-INDUCED POLYMERIZATION OF TRIOXANE. M. S. Akutin, N. S. Tikhomirova, and A. D. Ermolaev. Plasticheskie Massy, No. 12, 12-13(1963).

A study was made of the preparation of polyoxymethylene by the solid-state γ radioinduced polymerization of trioxane. The yield and viscosity of the polyoxymethylene were determined as a function of temperature, irradiation dose, dose rate, and trioxane crystal size. In the 20–115°C range at a constant irradiation dose (Co^{60} source, 0.54 Mrad) and constant dose rate (100 r/sec), the yield of polyoxymethylene increased with temperature to reach a maximum at the melting point, but the ln η of the polymer decreased with temperature from 0.82 at 20°C to 0.08–0.15 at 56°C. Polymerization did not take place at 0 to –196°C. Polymer yield increased with the integral irradiation dose and trioxane crystal size; the highest yield was 60% for large trioxane crystals at 0.54 Mrad, 100 r/sec, and 56°C. The ln η of the polymer increased with irradiation dose only between 0.24 and 0.36 Mrad, then sharply decreased, probably owing to polymer degradation at higher irradiation doses. Large trioxane crystals yielded a crystalline polymer that can be separated into individual fibers; small trioxane crystals yielded a powdery polymer. Post polymerization, which was observed in the irradiated trioxane, indicated that the radiation polymerization is free-radical in mechanism. Inhibition of trioxane polymerization in the presence of a free-radical polymerization inhibitor (hydroquinone and carbon tetrachloride) also indicated a free-radical polymerization mechanism. The polymer has a melting point of 178–180°C. A thermomechanical curve is given. (AID Press)

17912 COMPARISON OF ALPHA AND GAMMA RADIATION EFFECTS IN POLYETHYLENE. A. Charlesby, A. R. Gould, and K. J. Ledbury (Royal Military Coll. of Science, Shrivenham, Swindon, Wiltshire, Eng.). Proc. Roy. Soc. (London), Ser. A, 277: 348-64(Feb. 11, 1964).

Exposure of polyethylene and paraffins to high-energy radiation produces main chain (transvinylene) unsaturation, and this rises to a maximum limiting concentration with increasing dose. On the other hand, vinyl unsaturation initially present diminishes on irradiation. Comparison of the effects of α and γ irradiation of thin polyethylene films shows that the initial G value for the formation of transvinylene unsaturation is not significantly affected by the l.e.t. of the radiation, but the maximum values reached differ by a factor of over 4. Similarly the decay of vinyl unsaturation is four times slower with α radiation. The destruction of unsaturation is ascribed to the reaction of H atoms liberated by radiation with the unsaturated groups acting as a scavenger. The difference between α and γ radiation is due to an l.e.t. effect, more H atoms being available from radiation of lower l.e.t. Estimates are made of the proportion of H atoms which escape from the tracks of the two forms of radiation. The difference is much smaller than in the case of irradiated aqueous solutions. Data are also presented on the formation of carbonyl with α and γ radiation, both in the presence of air and during subsequent exposure. (auth)

17913 DECOMPOSITION OF THE INORGANIC CYANAMIDES. M. J. Sole and A. D. Yoffe (Cavendish Lab., Cambridge, Eng.). Proc. Roy. Soc. (London), Ser. A, 277: 523-39(Feb. 25, 1964).

A detailed study was made of the thermal decomposition of silver cyanamide crystals and powder, and also on the effect of pre-irradiation with γ rays, neutrons, and fission fragments. The decomposition is a complex process, and involves the formation of an intermediate. The physical

properties and decomposition behavior of silver cyanamide show that it is a covalent solid, and it is suggested that the initial step in the decomposition involves bond rupture (possibly the silver-nitrogen bond), the energy required being ca. 44 kcal/mole. The decomposition of sodium cyanamide, thallous cyanamide, and lead cyanamide was examined in outline. Where possible, infrared analysis, x-ray diffraction, and electron microscopy and diffraction, were used to supplement kinetic measurements. In many respects the decomposition of sodium cyanamide resembles that of sodium azide. Colors are produced within the solid, and the decomposition is dependent on impurities produced by hydrolysis, mainly at the surface. The basic mechanism, however, involves electron transfer, where two adjacent cyanamide ions react probably via an excited state. With lead cyanamide, it is found that cyanogen is given off preferentially. Lead cyanamide is also a covalent solid and bond fission occurs during decomposition. It is suggested that the first step is rupture of the weakest N–C bond. The differences in behavior of the silver, thallium, and lead salts can be understood in terms of the nature of the bonding orbitals between the metal atom and the cyanamide radical. (auth)

17914 ELECTRON ATTACHMENT IN IRRADIATED SOLUTIONS. G. E. Adams, J. H. Baxendale, and J. W. Boag (Mount Vernon Hospital, Northwood, Middx., Eng. and Univ. of Manchester, Eng.). Proc. Roy. Soc. (London), Ser. A, 277: 549-61(Feb. 25, 1964).

Transient absorption spectra were obtained by pulsed radiolysis and flash spectroscopy of neutral and alkaline solutions of benzophenone under anaerobic conditions. These spectra demonstrate the formation of the ketyl radical ion $(C_6H_5)_2C—O^-$ as a primary product resulting from electron attachment to benzophenone. In neutral solution, the rapid neutralization of the ketyl ion produces the neutral radical $(C_6H_5)_2C—OH$, and this is shown by a change in the optical absorption spectrum. Neither of the absorption spectra due to these species is observed in acid solutions. These observations show that in neutral and alkaline solution, the hydrated electron reacts directly with the solute, whereas in acid solution it is converted to the hydrogen atom before reacting with the solute. (auth)

17915 GAMMA-RAY INDUCED GRAFT COPOLYMERIZATION. VIII. GRAFT COPOLYMERIZATION OF STYRENE ON CELLULOSE ACETATE BY A PRE-IRRADIATION TECHNIQUE. Kiyoshi Hayakawa, Kaoru Kawase, et al. (Government Industrial Research Inst., Nagoya, Japan). Rept. Govt. Ind. Res. Inst., Nagoya, 12: 489-95(Oct. 1963). (In Japanese)

The γ-ray-induced graft copolymerization of styrene on cellulose acetate fibers by a pre-irradiation technique in air was studied. The grafting was not affected by the storing condition of the irradiated fibers, but the degree of grafting increased slightly with irradiation temperature from −78 to +100°C. The grafting seemed to be initiated by fairly stable peroxides produced in the irradiated fibers. The degree of grafting did not increase linearly but tended to saturate with the dose due to the decomposition of peroxides in the irradiated fibers by further irradiation. The rate of grafting showed 2.9 power dependence on the monomer concentration (as a benzene solution) at the dose rate of 6×10^4 r/hr. The grafting was completed within 60 min above 65°C, and the total degree of grafting decreased with the grafting temperature. Dependence of the molecular weight of grafted polystyrene (obtained by the hydrolysis of grafted fibers) and the total degree of grafting on the grafting temperature are discussed, and the activation energy of the peroxide decomposition was estimated to be about 25 kcal/mol. (from NSA of Japan)

17916 ELASTOMERS FOR USE IN RADIATION FIELDS. PART IX. COMPOUNDING CHLOROSULFONATED POLYETHYLENE FOR RADIATION, HEAT AND WATER RESISTANCE: RESULTS OF TESTS. Robert Harrington (General Electric Co., Richland, Wash.). Rubber Age (N. Y.), 93: 417-28(June 1963).

The effects of gamma radiation, heat aging, and hot water on Hypalon 20 and 40 compounds were studied and the results are reported. It is noted that the role of the compounding ingredients depends in large part on the amounts and combinations rather than on the specific type of material. For example, of the thirty-two ingredients used, all of them except magnesia appear to be satisfactory for use in Hypalon compounds to produce radiation, heat, and water resistance. The data also indicate that the cure system has a profound effect on the environmental resistance of Hypalon compounds. It is also shown that curing the materials with radiation, thus eliminating any residual unreacted materials that might be deleterious to the performance of the compounds, does not necessarily improve environmental resistance. The chlorosulfonated polyethylene polymer must be fortified with certain ingredients or combinations for maximum environmental resistance. It has also been shown that while it is relatively easy to compound Hypalon for resistance to any two of the environments in question, it is quite difficult to produce compounds with good resistance to all three of the environments. It was found that, for short periods of hot water immersion, water absorption is the primary effect. For prolonged periods of immersion, and as the water temperature is raised, there is a net effect between water absorption and extraction of some of the compounding ingredients. (P.C.H.)

17917 PROTON IRRADIATION OF AMMONIA. R. C. Horscroft (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Trans. Faraday Soc., 60: 323-34(Feb. 1964).

The radiolysis of ammonia gas below 1 atm was investigated under proton irradiation, using a Van de Graaff accelerator. The equilibrium concentration of ammonia was directly measured as from 3-7% ammonia by volume. The G value of ammonia decomposition was measured as a function of ammonia pressure, radiation intensity, and added nitrogen, hydrogen, and xenon pressure. Increasing ammonia pressure causes a small decrease in the rate of decomposition; a fall in decomposition rate is also observed with increasing intensity. An increase of 10^6 in the radiation intensity produces a fall in the G value from 4.0 to 1.6. Added xenon and nitrogen increase the decomposition rate, if the energy primarily absorbed in the ammonia only is considered. No hydrazine could be detected in the products. Some implications of these results are discussed. (auth)

17918 DISSOCIATION OF DIATOMIC MOLECULES DURING β DECAY. Yu. D. Oksyuk and V. I. Gerasimenko (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 46: 254-61(Jan. 1964). (In Russian)

The probability of dissociation of diatomic molecules during β decay of one of the nuclei is calculated. It is demonstrated that the results can be employed for determining the interaction constants between the electron-neutrino field and nucleons. (auth)

17919 BULLETIN OF THE CHEMICAL SOCIETY, BELGRADE. Milos Mladenovic, ed. Translation of

Glasnik Hemijskog Drustva, Beograd, 27: No. 9-10, (1962). 86p. $0.75(OTS) (OTS-62-11757/9-10)

Abstracts are given of the 78 papers that were presented at the 10th Meeting of PR Serbia and Annual Convention of the Serbian Chemical Society held in Belgrade, Jan. 28 to 30, 1963. Most of the papers cover various topics in radiochemistry, radiation chemistry, radioisotopes, separations, tracer techniques, labeled compounds, and activation analysis. A few non-nuclear chemical papers are also included. (D.L.C.)

17920 RADIATION INDUCED VULCANIZATION OF RUBBER LATEX. R. B. Mesrobian, D. S. Ballantine, and D. J. Metz (to U. S. Atomic Energy Commission). U. S. Patent 3,131,139. Apr. 28, 1964.

A method of vulcanizing rubber latex by exposing a mixture containing rubber latex and from about 15 to about 21.3 wt % of 2,5-dichlorostyrene to about 1.1 megarads of gamma radiation while maintaining the temperature of the mixture at a temperature ranging between from about 56 to about 59°C is described. (AEC)

Separation Processes and Procedures

17921 (ANL-6725(p.31-88)) PYROMETALLURGICAL DEVELOPMENT. (Argonne National Lab., Ill.).

An experiment was conducted to investigate the behavior of fission product iodine after it is condensed on a Fiberfrax fume trap in the melt refining process, the melt refining furnace is opened, and the trap is exposed to the argon atmosphere of the EBR-II Fuel Cycle Facility. The rate of iodine release was nearly constant over the period of 30 hr, with about 0.16% of the total activity in the Fiberfrax being released each hour. At 150°C, this rate was reduced substantially. The behavior of the activity was consistent with previous indications that the volatilized iodine activity is either cesium iodide or a material containing both of these elements. To prepare for possible future necessity of removing nitrogen from the argon atmosphere in the EBR-II Fuel Cycle Facility, studies were begun of the removal of nitrogen from argon with hot titanium sponge. Various Inconel, 300 series stainless steels, and Hastelloy steels were tested and evaluated for the containment of titanium sponge metal in argon at 900°C. The steel most resistant to attack by titanium was Type 316 stainless steel. However, because of its superior high-temperature strength, Hastelloy X was selected as the structural material for the high-temperature equipment. However, those parts of the high-temperature vessels which would come into contact with the titanium sponge will be lined with Type 316 stainless steel. Work continued on the development of the skull reclamation process for the recovery and purification of fissionable material present in the crucible residues (skulls) remaining after melt refining operations. The effects of various process changes were elucidated in small-scale (100 g of uranium) demonstration runs. An attempt to precipitate zirconium as a carbide from the uranium–magnesium–zinc solution present after the uranium-reduction step was unsuccessful. High uranium losses in the supernatant solution removed after precipitation of the uranium–zinc intermetallic compound were traced to excessive stirring (originally done to prevent accumulation of crystals on the vessel walls). The rate of extraction of ruthenium in the noble metal-extraction step was increased by increase in temperature within the permissible range of 650 to 800°C and by increase in the degree of mixing of the flux and metal phases. Operation of the large-scale integrated skull processing equipment was started. Further results were obtained on liquid-metal-solvent separation processes for fast breeder reactor fuels containing uranium and plutonium. A liquid metal process was developed for separating plutonium from EBR-II depleted uranium blanket material. In this process, the blanket material is dissolved in a magnesium–zinc solution; later, uranium is selectively precipitated from solution. Considerable iodine activity (about one-quarter of the total) was volatilized and was found condensed on the upper walls and top flange of the furnace chamber, but little iodine activity (about 0.1% of the total) was found in the furnace off-gases (as shown by trapping the iodine in a charcoal filter unit). No serious off-gas handling problem due to iodine was evident. As expected, ruthenium largely accompanied uranium through the process, while the rare earths, yttrium, and barium and strontium appeared predominantly in the plutonium product supernatant solution. The bulk of the zirconium and tellurium activities were not accounted for, only small percentages being found with either the uranium or the magnesium–zinc "product" solution. It is believed that these activities were removed by sorption on solid surfaces. The dilute plutonium product solution of the blanket process (about 0.1 wt % plutonium in a 50 wt % magnesium–zinc solution) must be concentrated by a factor of at least ten before it may be used for enriching the core material. Corrosion testing of tungsten and a 30 wt % tungsten–molybdenum alloy was carried out in a zinc-halide flux system employed in the skull reclamation process at a temperature of 1000°C. After 500 hr at 1000°C, tungsten was found, by metallographic examination, to be attacked intergranularly to a depth of 2 to 4 mils, and the molybdenum–tungsten alloy to a depth of 2 to 8 mils. Grain sizes were not greatly affected. Sharp edges remained on the specimens, and dimensional changes were less than 1%. Several experiments were made to determine the effects of small amounts of added impurities on the stability of uranium-containing magnesium–zinc systems. Beryllium added to the extent of 0.05 wt %, slightly over its solubility value, and aluminum added to the extent of 1 wt % had no effect on uranium concentrations. Silicon caused direct precipitation of the uranium. Stainless steel had no effect up to a concentration of 0.1%, but at a concentration of 1% caused a slight (less than 5%) decrease in uranium concentration. In order to take advantage of the good mechanical properties of porous coarse-grained crucibles for the containment of metal and salt systems, sealing the pores of such crucibles by impregnating the inner surfaces with a slurry of low-melting oxides was attempted. Subsequent firing of the crucible fuses the oxides, thereby sealing the pores. When properly applied to smooth surfaces, the coatings were impervious and strongly adherent, but imperfections in the coatings persisted in coatings applied to slightly rough surfaces. Various combinations of plasma-sprayed coatings and substrate materials are being evaluated for use as container materials in liquid metal-salt processes. Construction and testing of equipment for the preparation of 500-g batches of uranium monocarbide by precipitation from liquid metal solution were completed. The process consists of dissolution of uranium metal in zinc–magnesium alloy, addition of carbon, removal of the supernatant liquid metal, and retorting of the uranium monocarbide product to eliminate the remaining zinc and magnesium. Other methods for the preparation of carbides are also being developed. It was found that uranium monocarbide can be prepared by the reaction of magnesium carbide with uranium halides in molten chloride solu-

tions. Work was continued on the preparation of uranium monosulfide through the reaction of hydrogen sulfide with hydrided-dehydrided uranium metal, followed by homogenization at 1900°C. Further investigation of the zinc–magnesium reduction of thorium dioxide suspended in a molten halide flux indicated that a thorium dioxide-to-flux weight ratio of less than 0.2 is required for complete reduction under the following conditions: a flux consisting of 10 mol % magnesium fluoride in magnesium chloride, 10 wt % magnesium in the zinc at the end of the reduction, a temperature of 850°C, a period of 4 hr, and mixing at 1000 rpm. A brief study of crucible materials indicated that the use of graphite, silicon carbide, and alumina may result in contamination of the thorium product, but that tungsten appears to be a satisfactory crucible material. Plutonium dioxide is also reduced to the metal by the zinc–magnesium reduction technique. The reduction of plutonium dioxide was rapid and complete in fluxes of widely varying composition. The extent of plutonium dioxide reduction appears to be governed by the distribution coefficient of plutonium between the metal and the flux. Previous data on the reactions of the higher uranium oxides and the oxychlorides with molten chlorides indicated the formation of a uranium(V) species in solution which was tentatively identified as UO_2^+ ion. Comparison of the visible and near-infrared absorption spectrum of this species with the spectrum reported for the isoelectronic ion NpO_2^{2+} showed corresponding peaks. The ratios of wavelengths of the corresponding peaks were nearly constant. The UO_2^+ ion was formed by the thermal decomposition of uranyl chloride: $2\ UO_2Cl_2 \rightleftharpoons 2\ UO_2Cl + Cl_2$. A preliminary value of about 10^{-6} atm at 650°C was determined for the equilibrium constant of this reaction by determining the optical absorbance of UO_2^+ as a function of the chlorine pressure. (M.C.G.)

17922 (ANL-6725(p.88-99)) FUEL-PROCESSING FACILITIES FOR EBR-II. J. H. Schraidt, M. Levenson, and L. F. Coleman (Argonne National Lab., Ill.).

A series of tests was performed while the Argon Cell contained nitrogen at a pressure equal to the outside pressure to determine the effect of opening penetrations into the Argon Cell on the composition of the cell atmosphere. Three small penetrations were opened for periods up to 4 min without a significant increase in the oxygen concentration of the cell atmosphere. The opening of a 6-ft-diameter penetration into the cell caused the oxygen concentration of the cell atmosphere to rise to 300 ppm in 4½ min. A glovebox purification system was received at Idaho, leak tested, and successfully operated. Air leakage into the associated glovebox was found to be 0.015% per day of the glovebox-glovebox purification system volume. A second glovebox atmosphere purification system and two gas analytical instrument panelboards were tested and shipped to the Idaho site for installation. The top shielding plug of the Argonne fuel-transfer coffin was modified to overcome binding at sliding surfaces. The plug assembly was found to function satisfactorily after the modifications were completed. Tests were made to determine the behavior of sodium-coated fuel pins while contained in a stainless steel melt refining charging tray. The temperature of the tray was maintained at 450°C in one experiment and at 300°C in another experiment. The sodium coating evaporated from the fuel pins in both experiments and condensed on the cold areas of the test stainless steel containers. No interaction occurred between the pins and the stainless steel containers. A second skull-oxidation furnace is being designed, which will allow the heater-cover assembly to be disposed of in a standard waste container if the heater attached to the cover should fail. The furnace atmosphere control system was successfully tested during the oxidation of 12 skulls, which ranged in weight from 300 to 1300 g. Tests with inductive heating and mixing demonstrated that greater than 80% reduction of uranium oxide by 5 wt % magnesium–zinc alloy can be obtained in 2 hr at 800°C. The weight of the skull oxide charge used in the tests was 2½ kg. Studies on the collection of metal vapors were continued. With an improved apparatus, four runs were made in which 2-kg charges of magnesium–zinc were distilled at rates of 25, 32, 48, and 62 g/min. In the first three runs, no loss of magnesium–zinc occurred. In the fourth run, 17 g of magnesium–zinc distillate escaped from the graphite enclosure and deposited on the Fiberfrax insulators. (auth)

17923 (ANL-6725(p.113-31)) LABORATORY INVESTIGATIONS OF FLUORIDE VOLATILITY PROCESSES. J. Fischer (Argonne National Lab., Ill.).

In the conceptual flowsheet of the fluid-bed fluoride volatility process, the uranium and plutonium content of spent oxide fuels is recovered by fluorination to produce the volatile hexafluorides of uranium and plutonium. Laboratory-scale work was concerned with the fluorination of U_3O_8 in a 1½-in.-diameter fluid-bed fluorinator. This work is being performed to develop and test apparatus and procedures for use in future work in which plutonium will be handled. The oxide U_3O_8 is being used because it is the product which will be obtained in a proposed oxidative "decladding" step for removing the uranium and plutonium from stainless steel-clad and Zircaloy-clad fuel elements. The powdered U_3O_8 is injected into the fluid bed with the fluidizing nitrogen stream. Fluorine is brought into the bed just above the point at which the powder enters and the fluorination reaction occurs as the U_3O_8 and fluorine mix. A reaction scheme employing two periods at a reaction temperature of 500°C was developed; in the first period, the U_3O_8 is fed into the bed and fluorination is carried out with 20 vol % fluorine in the gas phase; in the second period a gas phase containing 100% fluorine is recirculated through the fluid bed for a period of 5 hr. By means of this reaction scheme, more than 99% of the U_3O_8 fed to the reactor was converted to uranium hexafluoride. The oxidation of uranium dioxide, which results in the formation of a finely divided U_3O_8 powder, is being considered as part of a decladding step for stainless steel- and Zircaloy-clad fuel elements. Fuel-element mockups were oxidized in a fluid bed at 450°C with air as the oxidant and fluidizing gas. Slots were milled along the length of the cladding tubes to promote splitting of the cladding. It was found that the time necessary to completely split open a section of cladding along the slit line was dependent on the thickness of the tubing. For 10- and 20-mil wall thicknesses of stainless steel, the tubing split open along its entire length after 2 and 4 hr of oxidation, respectively. For 30-mil Zircaloy, the tubing was completely split after 6 hr of oxidation. Complete removal of the U_3O_8 product was accomplished by 1 to 2 hr of further oxidation. Rates were measured by means of a thermobalance for the reaction of U_3O_8 with fluorine over the temperature range from 300 to 400°C. Two samples of U_3O_8 were used; one was an analytical standard sample, the other a commercially produced material. The data were treated by a diminishing-sphere kinetic model, which relates the reaction rate constant k (in units of min^{-1}) directly to a function of the fraction of the oxide remaining after a reaction time t. The reaction rate constants for the commercially produced material

were slightly higher than those for the analytical standard sample at the same temperatures. An average value of 30 kcal/mole was calculated for the activation energy of this reaction which, within experimental error, is the same for both materials used. Equations are given that relate the change in reaction rate constant with temperature. An estimate of the time required to completely convert a particle of U_3O_8, of about 10-micron diameter, to uranium hexafluoride, based on an extrapolation of the rate constant to 500°C, was less than 2 min. Studies of the effect that the addition of helium to plutonium hexafluoride has on the decomposition of plutonium hexafluoride by gamma irradiation were continued. Additional data gave G values of 7.2 ± 1.1 and 5.8 ± 0.8 for experiments in which one atmosphere and two atmospheres of helium, respectively, were added. A comparison of these G values with the G value of 7.5 ± 0.7 obtained for the decomposition of plutonium hexafluoride alone indicated that helium does not significantly influence the decomposition. (auth)

17924 (ANL-6725(p.131-90)) ENGINEERING-SCALE INVESTIGATION OF FLUID-BED FLUORIDE VOLATILITY PROCESS. A. A. Jonke (Argonne National Lab., Ill.).

Engineering-scale investigation of a fluid-bed fluoride volatility process for the recovery of uranium and plutonium from discharged UO_2 fuels was continued. The major objectives were to demonstrate short batch fluorination time (less than 20 hr) and satisfactory fluorine utilization efficiencies (greater than 75%). The latest and most successful runs employed a two-zone oxidation-fluorination technique. Removal of UO_2 fuel from stainless steel cladding by oxidation of the UO_2 to U_3O_8 and the physical disengagement of the U_3O_8 from the cladding is being tested. Additional experiments were made with alternate steps of oxidation and reduction of the UO_2, which promotes its pulverization. A facility is being constructed for engineering-scale studies of the steps of a fluid-bed fluoride volatility process for recovery of fissionable materials from spent fuel of the UO_2 type and for reconstitution of the oxide fuel material after it is freed from fission products. Process piping and valve installations in a large alpha containment box and in the fluorine gas storage and supply system were completed. The factors that affect the filtration of products of the hydrolysis of PuF_6 are being studied. A basic investigation of the mixing of fluidized particles in the voids of a packed bed of larger, nonfluidized bodies was carried out in support of the development of the fluid-bed fluoride volatility process, which involves the use of inert fluidized particles to remove heat generated by the fluorination of UO_2. Development work on a fluid-bed volatility process for recovery of enriched uranium from low uranium-high alloy fuel is in progress. Adaptability of the fluid-bed hydrolysis scheme to the conversion of $AlCl_3$ vapor (simulated waste from the processing of aluminum alloy fuels) to the more readily stored oxide was demonstrated. Process development studies of a fluid-bed scheme for preparing dense UO_2 particles directly from UF_6 were continued. A method of densifying low-density UO_2 is being sought. (M.C.G.)

17925 (BM-RI-6396) NAPHTHENIC ACID SOLVENT EXTRACTION OF RARE-EARTH SULFATES. D. J. Bauer and R. E. Lindstrom (Bureau of Mines. Reno Metallurgy Research Center, Nev.). July 1963. 21p.

Studies were conducted to assess the potential of naphthenic acid as a fractional extractant for rare-earth mixtures and yttrium in sulfate solution. Naphthenic acid was an effective extractant, and separation factors were favorable in the presence of aqueous phase chelating agents. Addition of EDTA to the naphthenic acid extraction system resulted in average separation factors of 2.2 between adjacent yttrium-group elements, whereas DTPA resulted in average separation factors of 3.5 between adjacent cerium-group elements. EDTA was of value in separating yttrium from the rare-earth elements. Thorium and uranium were preferentially extracted over the trivalent rare-earth elements by naphthenic acid. (auth)

17926 (BM-RI-6409) ALKALINE LEACH PROCESSING OF A SUBGRADE CALCAREOUS URANIUM ORE. K. E. Tame (Bureau of Mines. Salt Lake City Metallurgy Research Center). Apr. 1963. 13p.

An alkaline leaching procedure for recovering uranium from a submarginal 0.1 percent U_3O_8 calcareous carnotite ore from the Shiprock, N. Mex., area was investigated. A recovery of 72 percent of the uranium was attained in a preliminary test embodying the commonly accepted practice of (1) alkaline leaching at 90°C, (2) multiple stage filtration and washing for recovery of a clear pregnant solution, and (3) caustic precipitation of uranium as sodium diuranate, with recycle of the barren solution to the leaching and washing circuits. Ion exchange resins were used in a second, less orthodox test that comprised (1) sodium carbonate leaching of minus 10-mesh ore at 90°C to dissolve the uranium, (2) filtration to recover the leaching reagent for reuse, (3) recovery of the uranium-bearing solution in the filter cake as a pregnant slime slurry by repulping of the filter cake followed by a sand-slime separation and countercurrent decantation (CCD) washing for rejection of the sand fraction, (4) recovery of the dissolved uranium from the pregnant slime slurry by resin-in-pump (RIP), (5) elution of the uranium from the resin with a solution of ammonium chloride acidified with hydrochloric acid, and (6) precipitation of the uranium with ammonia gas. About 83 percent of the uranium was extracted from the ore and 95.5 percent of the dissolved uranium recovered by ion exchange. Improved laboratory results were obtained using the RIP process, but larger scale tests would be necessary for economic evaluation of the two processes. (auth)

17927 (EUR-437.f) L'EXTRACTION LIQUIDE-LIQUIDE PAR LES OXYDES D'ALKYLPHOSPHINE. (Liquid-Liquid Extraction by Alkyl-phosphine Oxides). G. Duyckaerts and J. Goffart (Liège. Université). 1964. 83p.

The determination of actinide and lanthanide nitrates extraction from a nitric solution into a tri-n-octyl- or tri-n-butyl-phosphine oxide organic solution has been investigated; the results obtained for Am, La, Ce, Pm, Eu, Gd, Tb, Ho, Er, Tm, Yb, Lu, and Y are discussed. The extracted complex has the formula $Me(NO_3)_3 \cdot 3TBPO$. In order to obtain a quantitative interpretation of these distribution curves and to determine the stability constants of these complexes, it is necessary to know the HNO_3, TBPO, H_2O distribution between the two phases. This study allowed the determination of the apparent stability constants for two molecular complexes:

$$TBPO_0 + H_a^+ + NO_3^- \rightleftharpoons TBPO \cdot HNO_{3_0} \quad K_1' = 17.5 \pm 1 (l/M)^2$$

(benzene)

$$TBPO \cdot HNO_{3_0} + H_a^+ + NO_{3_a}^- + H_2O \rightleftharpoons TBPO \cdot 2HNO_3 \cdot H_2O_0$$

$$K_2' = (2.7 \pm 0.5)\ 10^{-3}\ (l/M)^2 \text{ (benzene)}$$

(auth)

17928 (HW-79355) A METHOD OF DETERMINING THE PHYSICAL STRENGTH OF ION EXCHANGE RESIN. T. R. McKenzie (General Electric Co. Hanford Atomic

Products Operation, Richland, Wash.). Sept. 13, 1963. Contract AT(45-1)-1350. 13p.

A method has been developed which allows the determination of the physical strength of ion exchange resin. The resin sample is tested by selecting an aliquot of beads. Each bead is tested and the measurements obtained are programmed under the code name "Squash" on the IBM 7090 computer. The results are analyzed statistically giving the following data: (1) The size of the bead to the nearest 0.005 mm. (2) The total force, to the nearest gram, required to rupture the bead. (3) The deformation, to the nearest 0.005 mm, the bead underwent prior to rupture. (4) The force/unit area (grams/mm^2) required to rupture the bead. The reproducibility of the method was checked by selecting three sets of 20 beads from the same sample, and determining only the force required to rupture the beads. The beads were selected for soundness and were all approximately the same size. The statistical analyses of these runs show a variance of the mean values of less than 1.0%. For the worst case, the precision of the mean at the 95% S.L. shows a maximum variance of less than 10.0%. The practicability of the method was checked by comparing Permutit-SK resin before and after irradiation in a ^{60}Co source. A comparison of the results obtained shows that the method will readily detect the physical damage caused by 1.48×10^8 r gamma radiation. In the case cited, the force required to rupture the beads exposed to radiation had decreased 25% from their normal value. With this type of data resin samples can be compared to previous samples of the same type to ascertain relative physical qualities of the resin prior to use. One can correlate length of service to physical strength and determine remaining life of resin in use. One can also determine what effects such variables as radiation, chemical treatment, time in the pushed bed unit, etc. have on the physical characteristics of the resin. (auth)

17929 (IDO-14616) CHEMICAL PROCESSING TECHNOLOGY QUARTERLY PROGRESS REPORT, JANUARY–MARCH 1963. J. R. Bower, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Sept. 9, 1963. Contract AT(10-1)-205. 37p.

Aqueous Zr fuel processing studies resulted in a recommendation for changes which would increase the capacity of the ICPP HF dissolution process to 835 kg of Zr per day. Involved are modifications of the existing dissolver to permit semi-continuous dissolution, and use of natural B in the dissolvent to serve as a neutron poison for criticality control. No B was found in solid dissolver residues over an addition range of 0 to 6 g/l; 4 g/l is the proposed B addition level. Non-B containing dissolver residues, which were as high as 0.14 g/l when the dissolvent B content was 2 g/l or less, and as high as 0.28 g/l when the B level was 4 to 6 g/l, were found primarily to be undissolved Sn at the lower level, and to contain ZrF_4 hydrolysis products at the higher level. Indications are that the presence of B will require higher concentrations of fluoride to maintain stability of adjusted dissolver solutions. Otherwise the addition of up to 6 g/l of B as boric or fluoboric acid had no appreciable effect on the dissolution, adjustment, or extraction steps. B remained in solution throughout both dissolution and adjustment operations, was not volatilized during evaporation steps, and was not carried out of solution on deliberately generated Zr or U precipitates. Additional studies reported include corrosion evaluations of Monel and Carpenter-20 in HF dissolver solutions, and evaluation of austenitic stainless steels for use in storage of Zr process wastes. Electrolytic dissolution studies led to the installation and testing of a subscale pilot unit. Solution contact operation in the horizontal model dissolver appears satisfactory although initial operation resulted in perforation of the vessel. This was avoided in succeeding runs by making the shell cathodic. In other laboratory studies, contact resistance measurements (2 to 3 milliohms) between a full scale APPR element and a Ti cone dissolver base, together with other observations on the metal-to-metal contact principle, suggest that a stack of such elements in a tall basket type dissolver might draw 2000 amp without significant damage to the contact surface. Further progress is reported on the electrodissolution of Al fuels to give high molarity (>4M Al), catalyst-free dissolver solutions. Results of waste treatment studies, directed at adsorption of fission products from low-level wastes on natural earth materials, indicated that the presence of EDTA or citric acid, common decontamination complexing agents, could markedly affect the adsorption. The melt-freeze $Al(NO_3)_3$ separation process was studied in runs of several hours' duration in a four-stage laboratory unit, but design changes are indicated and studies are underway to provide the design bases. Results of supersolubility studies on $Al(NO_3)_3 \cdot 9H_2O$ in HNO_3, involved in the initial crystallization of the feed solution, are reported. The ICPP waste calcining facility was tested with radioactive tracer feed, found to meet desired or required operating standards, and is being readied for production operation with ICPP stored wastes. Results of studies on calciner air distributor cap design, and corrosion resistance of cemented tungsten carbide slide-valves used in the system, are summarized. Plant improvement studies include testing of the effects of dissolver solution recirculation in continuous dissolution of Al fuel. Requirements for $HgNO_3$ catalyst were reduced significantly when either forced or natural recirculation was used. Uniformity of product composition, however, was not improved as had been anticipated. Other improvement items on which progress is reported include methods of pulse column interface control, true liquid level determination in process evaporators, and absorption of degradation products of tributyl phosphate from first cycle extraction product. (auth)

17930 (IDO-14625) CHEMICAL PROCESSING TECHNOLOGY. Quarterly Progress Report, July–September 1963. J. R. Bower, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Feb. 24, 1964. Contract AT(10-1)-205. 51p.

Processing operations resulted in overall recovery of 99.8% of the U from Al–U type fuels (12 varieties) available for processing. Dissolution and first cycle extraction were conducted at an average rate of 24 kg of U per day for MTR-ETR fuel and at lower rates for other fuels; overall plant and individual cycle decontamination was equivalent to that of earlier Al processing runs. Newly modified processing equipment, including large volume neutron-poisoned rework and recovery equipment, and a TBP solvent decontamination unit, performed satisfactorily. Dissolution of refractory Al–U fuel was not accelerated by an attempted contact activation, but the data suggest that the lower burnup alloy from the interior of a fuel slug is preferentially dissolved, leaving a hard-to-dissolve shell containing the higher burnup alloy. Zirconium fuel processing studies led to significant results in a number of areas. It was found that the use of dissolved B as a neutron poison does not affect dissolution processes or the stability of the resulting Al-complexed solutions, and that U-Zircaloy-2 fuel was dissolved continuously by an aluminum nitrate-hydrofluoric acid dissolvent, but a corro-

sion resistant container material may not presently be available for this reagent. UO_2-ZrO_2 wafers from advanced PWR fuel were dissolved at good rates in concentrated hydrofluoric acid, eg, 5 mg/(cm²)(min) at 20 M acid, and the addition of oxalic acid to hydrofluoric acid dissolver reagent gave about a 50% increase in U solubility. Corrosion tests of Monel and Carpenter-20 in Zr dissolver product solution showed that Monel had uniform corrosion rates of up to 5 mils/month; Carpenter-20 had lower average corrosion rates but showed greater susceptibility to localized attack. Dibutyl phosphate was found to be generated in unexpectedly large amounts in the first cycle extraction column, and only in small amounts in the first cycle product evaporator, in the first detailed study of TBP and its degradation products under ICPP operating conditions. Distribution of various phosphate species in first cycle streams is reported and analyzed critically. A laboratory-scale hydrated ZrO_2 adsorber for DBP was successfully regenerated with 1M NaOH; 97% of the adsorbed DBP was eluted with 12 column volumes of wash solution. Electrolytic dissolution tests in the Model 1 pilot dissolver gave uniform dissolution (in any horizontal plane) of bundles of ¾-in., type 304 stainless steel tubing at a current utilization factor of 1.9 g/(amp)(hr). Tests to date indicated desirable design changes, and a Model 2 dissolver is being readied for installation. Several batch dissolutions of irradiated OMRE fuel indicated that irradiation has little effect upon the dissolution process but that decontamination of dissolver components may be difficult. Other subjects studied include dissolver size from the standpoint of nuclear safety, reliability of charging fuel in the correct orientation, and mechanical requirements of dissolver insulating materials. Studies on decontamination of aluminum nitrate by the freeze-melt technique indicate that 500 g of aluminum nitrate should be recovered for each gram retained in the scrub solution with the fission products. While conditions existing in the pilot unit favor nucleation rather than crystal growth, a tendency toward agglomeration of small crystals gives settling rates adequate to make the unit operable. Measurement of the solubility of strontium nitrate in the nitric acid-aluminum nitrate scrub solution from the apparatus indicates that strontium should not precipitate in the scrub solution-fission product concentrate. Waste calcining facility modifications were completed this period in preparation for operation with high-level ICPP aluminum nitrate waste solution. A summary of the safety analysis of this facility is presented. Nuclear poisoned fuel storage racks, designed to permit closer spacing of fuel elements in the storage canal, are discussed and pictured in some detail. (auth)

17931 (IDO-16912) POLYPHENYL ANALYSIS. P. W. Solomon (Phillips Petroleum Co. Research and Development Dept., Bartlesville, Okla.). Mar. 31, 1964. Contract AT(10-1)-1080. 144p.

Inorganic salts on inert supports were investigated as column packings in gas chromatographic separations of organic compounds. The packings proved highly satisfactory for separating polyphenyls from biphenyl through p-hexaphenyl. Columns for the analyses must possess high-temperature stability (200-500°C). Salts found to give good separations of polyphenyls are: LiCl, CsCl, $SrCl_2$, $CaCl_2$, K_3PO_4, and certain mixtures of these. They were satisfactory for both qualitative and quantitative analyses. Other types of organic compounds besides polyphenyls such as fused-ring aromatic, aralkyl, and aliphatic hydrocarbons, aromatic amines, nitro compounds, haloaromatics, aromatic ketones, and quinones were satisfactorily separated. Lithium chloride columns (one inch diameter) were successfully used for preparatory scale work. Adequate resolution was obtained with the large-scale column. However, a small sample must be used because the capacity of the salt columns is less than that of the conventional organic-type columns. A conventional thermal-conductivity-type detector proved adequate for preparatory scale work. With the gas solid columns, elution temperature and elution order of the polyphenyls were found to vary with the type of salt, its concentration on the support, and the firing temperature used in the column preparation. The resulting peak shifts were correlated with molecular structure, and with the help of several hexaphenyls of known structure, a theory was developed that was used to predict the elution position of a variety of other hexaphenyls. Hexaphenyls produced by electron irradiation of pure o-, m-, and p-terphenyl were isolated and characterized by means of the inorganic salt columns. Structure predictions from the theory were verified by trapping the unknown peaks and determining their structure by infrared analysis. In addition, a newly developed radiolysis model predicts that certain hexaphenyl isomers will be formed in larger yields than others. Thus, from the amount of each hexaphenyl, additional evidence was found to support the predicted elution temperature. (P.C.H.)

17932 (ORNL-3465) EVALUATION OF AN ENGINEERING DEMONSTRATION OF THE MODIFIED ZIRFLEX AND NEUFLEX PROCESSES FOR THE PREPARATION OF SOLVENT EXTRACTION FEEDS FROM UNIRRADIATED ZIRCONIUM-BASE REACTOR FUELS. F. G. Kitts (Oak Ridge National Lab., Tenn.). Mar. 1964. Contract W-7405-eng-26. 65p.

In order to recover uranium from zirconium-base reactor fuels by solvent extraction, the metallic fuel and cladding must first be dissolved and a suitable feed solution prepared. Such preparations of solvent extraction feeds were successfully accomplished batchwise using both the Modified Zirflex and Neuflex processes employing an NH_4F-oxidant mixture to dissolve the fuel elements, and $HNO_3-Al(NO_3)_3$ and H_2O additions to adjust the feed. (The $HNO_3-Al(NO_3)_3$ mixture is used to adjust Modified Zirflex feed, and H_2O for the Neuflex feed.) In the Modified Zirflex process, a dissolvent about 6 M in NH_4F with an excess of NH_4NO_3 is used, along with a continuous addition of H_2O_2 to oxidize uranium to the more-soluble U(VI) valence state. The off-gas, after NH_3 removal, is an H_2-O_2 mixture of small volume, which is diluted with air to a safe concentration. Then nitric acid-aluminum nitrate is added to the dissolution product, yielding a solvent extraction feed from which uranium is recovered by using TBP-Amsco as the extractant. In the Neuflex process, the dissolvent is $NH_4F-H_2O_2$, with less than a stoichiometric amount of NH_4NO_3. Without NH_4NO_3, the scrubbed off-gas is principally hydrogen, on the hydrogen-rich side of the flammable range of H_2-O_2 mixtures. Only water is added to this dissolution product, yielding a neutral fluoride feed from which uranium is extractable by use of Dapex reagents. In both processes the F:Zr charge ratio, initial surface condition, and maximum section thickness of the fuel element were the principal determinants of total dissolution time. The zirconium loading as determined by the free fluoride–zirconium solubility relationship limited the capacity of fuels containing less than 2% U, while the free-fluoride-to-uranium ratio of about 100 required for solution stability was the limiting factor with alloys containing higher percentages of uranium. Hy-

drogen peroxide concentration was not an important factor in solution stability; the role of ammonia or NH_4OH was not studied. The feasibility of both processes was demonstrated by a series of batch dissolutions of kilogram quantities of various fuels containing 1 to 8% uranium. Continuous dissolution was demonstrated as was application to TRIGA fuel alloy (8% U–ZrH). Stainless steel type 347 and a low-carbon nickel alloy were suitable materials of construction for the dissolution and the solvent extraction equipment. Since there were some discrepancies between small-scale and engineering-scale work, especially in the prevention of precipitate formation near the end of the dissolution cycle, it is advised that some further investigation be made prior to attempted scaleup to plant operation. (auth)

17933 (ORNL-3533) THE PERFORMANCE OF AN ADVANCED EXPERIMENTAL STACKED-CLONE CONTACTOR: A HIGH-PERFORMANCE SOLVENT EXTRACTION MACHINE WITH POTENTIAL FOR APPLICATION TO VERY HIGHLY RADIOACTIVE SOLUTIONS. M. E. Whatley and W. M. Woods (Oak Ridge National Lab., Tenn.). Apr. 1964. Contract W-7405-eng-26. 55p.

A high-performance liquid-liquid extraction contactor, called the stacked-clone contactor, has been developed through the stage of identifying an optimum design of the configuration of the functioning components. The device consists of hydroclones cascaded such that the underflow port of each hydroclone communicates with the overflow of the one below by an underflow chamber. Each stage is comprised of a hydroclone, an underflow chamber, and a pump. The contactor is under development for application with highly radioactive solutions where contact time must be minimized to reduce the degradation of the solvent by radiation damage. Contact times of less than 4.5 sec per theoretical stage have been reached in the experimental model, and contact times of less than 2.5 sec are probable by improving the design to eliminate nonfunctional volume. The throughput of the experimental model was about 4 liters/min at a stage efficiency of 65 to 80%. The stage efficiency and entrainment was relatively independent of throughput. The performance of the contactor was temperature dependent. Although the unit does require pumps at each stage, there is only one control point necessary: the top interface. The simplicity, stability, and rapid response of the contactor promise that it will be a very usable device. The principle of operation and the characteristics of the stacked-clone contactor are discussed. (auth)

17934 (ORNL-3586) THE REMOVAL OF URANIUM AND THORIUM FROM FUELED-GRAPHITE MATERIALS BY CHLORINATION. J. L. Cook and R. L. Hamner (Oak Ridge National Lab., Tenn.). Apr. 1964. Contract W-7405-eng-26. 28p.

A nondestructive process was developed for the removal of exposed uranium and thorium from fueled-graphite spheres for gas-cooled pebble-bed reactors. Volatile chlorides were formed and removed by reacting exposed uranium and thorium at high temperature with a dynamic atmosphere of gaseous chlorine diluted with argon. Chlorination experiments were conducted at 800 to 1000°C with uncoated spherical UC_2 and $(U,Th)C_2$ particles, pyrolytic-carbon coated fuel particles, and graphite matrices containing coated fuel particles. The results were evaluated by radiography, chemical analyses, x-ray diffraction analyses, and alpha assay. It was concluded that exposed uranium alone was more readily removed by chlorine treatment than exposed uranium-thorium combinations, but that both could be removed by treating for 16 hr at 1000°C in a gaseous flow of 80 cm^3/min Cl_2 and 125 cm^3/min Ar. (auth)

17935 (ORNL-TM-532) FISSION PRODUCTS. Progress Report, December 1962–January 1963. R. E. McHenry, comp. (Oak Ridge National Lab., Tenn.). June 16, 1963. Contract [W-7405-eng-26]. 34p.

Progress is reported on elution of ^{137}Cs from Decalso beds, solvent extraction of cesium, solvent extraction recovery of strontium and rare earths, performance testing of air-pulsed mixer-settler, rare earth fractionation by ion exchange, and removal of radioiodine from hot off-gas system by charcoal adsorption. (M.C.G.)

17936 (ORNL-TM-800) BIBLIOGRAPHY OF ROVER FUEL PROCESSING AND MOLTEN SALT FLUORIDE VOLATILITY PROCESS DEVELOPMENT STUDIES AT OAK RIDGE NATIONAL LABORATORY. J. C. Bresee (Oak Ridge National Lab., Tenn.). Apr. 1964. Contract [W-7405-eng-26]. 20p.

A complete bibliography was assembled of Rover fuel processing and molten salt fluoride volatility processing research at, or sponsored by, Oak Ridge National Laboratory. The bibliography contains open literature references, topical reports, status and progress reports, and technical memoranda. (auth)

17937 (PAEC(D)CH-638) TRACER STUDIES. IV. SOLVENT EXTRACTION OF STRONTIUM AND COBALT FROM AQUEOUS SOLUTION. O. S. Pascual and N. Egay (Philippines. Atomic Energy Commission, Manila). 1963. 15p.

^{60}Co and ^{90}Sr were used in tracer studies of the solvent extraction of Co and Sr using various complexing agents in conjunction with $CHCl_3$. For Sr, the complexing agents studied were EDTA, cupferron, 1-NO 2-naphthol, and oxine; only oxine resulted in appreciable separation from aqueous solutions. For Co, both 1-NO 2-naphthol and oxine gave separation. The liquid-liquid countercurrent extraction of Sr and Co was studied using oxine. In the stepwise separation of Sr and Co from aqueous mixtures, two procedures using (a) 1-NO 2-naphthol to extract Co and then 10% oxine for Sr and (b) 1% oxine to extract Co and then 10% oxine for Sr, gave clean separations. (D.L.C.)

17938 (RT/CHI(63)-34) COMPORTAMENTO DEL S.A.P. ALL'ATTACCO DI SOLUZIONI DI ACIDO NITRICO E NITRATO MERCURICO. (Behavior of S.A.P. in the Mercury Catalyzed Nitric Acid Dissolution). G. Beone (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Oct. 1963. 43p.

Plates of S.A.P. (sintered Aluminum Powder) were dissolved under different conditions in a nitric acid solution containing mercuric nitrate as a catalyst. These experiments aim at establishing a head-end dissolution process for S.A.P. cladded uranium oxide fuels. The results of preliminary dissolution experiments on simulated fuel rods are also described. The behavior of S.A.P. in the mercury catalyzed nitric acid dissolutions differs strongly from the behavior of aluminum: reaction rates are very low for S.A.P. and the dissolution time borders on being unacceptable in an industrial process. Settling rates of suspended alumina are however favorable. A tentative head end flowsheet lay out for PRO second core fuel elements is included. (auth)

17939 (TID-20461) FOAM SEPARATION OF METALLIC IONS FROM SOLUTION. Final Report. Eliezer Rubin, Charles LaMantia, and Elmer L. Gaden, Jr. (Columbia Univ., New York). Mar. 31, 1964. Contract AT (30-1)-2290. 158p.

Foam Separation of Metals. The relationships between

the more important factors in foam separation of surface active solutes and metal ions were studied theoretically and experimentally. An ideal foam model was utilized in deriving a "distribution factor equation" relating surface excess Γ, concentration in the bulk liquid x, concentration in the collapsed foam y, foam ratio, f, (ml liquid/ml foam) and bubble diameter D. An adsorption model was found useful in relating the distribution factor of the metal ions $(\Gamma/x)_{Me}$ to the distribution factor of the foaming agent, $(\Gamma/x)_A$. Three systems were studied experimentally using a circulatory type foaming apparatus: Aresket 300 (monobutyl biphenyl sodium sulfonate), Aresket 300 + UO_2^{2+}, and Aresket 300 + Sr^{2+}. The experimental results were found to be in good agreement with theory. Experimental studies of the properties of Aresket 300 foams moving in a vertical column resulted in a general correlation relating the average thickness of the walls separating the gas bubbles, (f · D)/6, to the linear foam velocity. The factor (f · D)/6 was found to be independent of foam height and foaming agent concentration. Finally, using the theoretical and experimental findings, an approach to the design of continuous foam separation systems is presented. Dynamic Properties of Foam Columns. The effects of wide variations of bubble diameter and column diameter upon the previously discovered linear relationship between (f · D) and log v were investigated. It was found that the correlation did not satisfactorily account for large variations in bubble diameter and was affected by changes in column diameter. Data over the entire range of bubble and column diameters investigated were adequately described by a linear relationship between log $(fD^2D_c^2)$ and log v. (auth)

17940 HIGH SPEED SEPARATION OF THE LIGHT RARE EARTHS ON CENTRIFUGALLY ACCELERATED ION-EXCHANGE PAPER. Clarence Heininger, Jr. and Frank M. Lanzafame (St. John Fisher Coll., Rochester, N. Y.). Anal. Chim. Acta, 30: 148-54(Feb. 1964).

The separation of the rare earths, La, Ce, Pr, Nd, Sm, and Y on centrifugally accelerated Amberlite SA-2 cation-exchange paper was studied. All combinations of the elements can be completely separated except the Pr–Nd pair by using as eluant glycolic acid of a properly chosen concentration (0.30 or 0.40 M) and pH (3.0 to 4.5). The Pr–Nd pair can be partially separated. The average number of ligand glycolate ions per rare earth ion in the resin phase was determined for each rare earth over the pG range 0.7 to 1.0. (auth)

17941 THE ANION-EXCHANGE SEPARATION OF TITANIUM, ZIRCONIUM, NIOBIUM, TANTALUM, MOLYBDENUM AND TUNGSTEN, WITH PARTICULAR REFERENCE TO THE ANALYSIS OF ALLOYS. E. J. Dixon and J. B. Headridge (Sheffield Univ., Eng.). Analyst, 89: 185-204(Mar. 1964).

A detailed study was made of the adsorption of titanium, zirconium, niobium, tantalum, molybdenum, and tungsten on the anion-exchange resin, De-Acidite FF, from solutions containing mixtures of two or more of hydrofluoric acid, hydrochloric acid, ammonium fluoride, and ammonium chloride, with a view to obtaining a separation scheme for these elements that could be completed within 5 hours. A completely satisfactory separation scheme was achieved, after determining the weight-distribution coefficients of the elements between aqueous solutions of the above reagents and the resin, and after investigating numerous elution curves for the elements from columns of the resin. Titanium(IV), zirconium, niobium(V), tantalum, molybdenum(VI), and tungsten(VI) were retained on the resin and separated from aluminum, vanadium(IV), chromium(III), manganese(II), iron(III), cobalt(II), nickel, and copper(II), by passing a solution of these elements in M hydrofluoric acid, followed by a wash solution of M hydrofluoric acid, through a column of the resin, of 100- to 200-mesh size, in the chloride form. Titanium plus zirconium, tungsten, niobium, molybdenum, and tantalum were then quantitatively eluted from the resin with 0.01 M hydrofluoric acid–9 M hydrochloric acid, 3 M hydrofluoric acid–10 M hydrochloric acid, 0.2 M hydrofluoric acid–7 M hydrochloric acid, 3 M hydrofluoric acid–3 M hydrochloric acid, and M ammonium fluoride–4 M ammonium chloride mixtures, respectively. Good results were obtained when the scheme was applied to the separation of the elements in synthetic mixtures and alloys, in which instances spectrophotometric or volumetric methods were used for quantitatively determining the separated elements. (auth)

17942 MODERN METHODS FOR THE SEPARATION AND CONTINUOUS MEASUREMENT IN THE GAS PHASE OF COMPOUNDS LABELED WITH RADIOCARBON; RADIO AND REACTION GAS CHROMATOGRAPHY. F. Drawert and O. Bachmann (Forschungsinstitut fuer Rebenzuechtung Geilweilerhof, Siebeldingen/Pfalz, Ger.). Angew. Chem. Intern. Ed Engl., 2: 540-5(Sept. 1963).

Instrumentation for radio gas chromatography (liquid scintillation counters, ionization chambers, and Geiger-Müller or proportional counting tubes) is discussed. Methods of measurement are described. Since there is no counting method available by which every ^{14}C-labeled compound can be determined as such with good sensitivity and reproducibility, gas-chromatographic fractions were converted either into CO_2 by ignition or into methane before measurement of their radioactivity. In this way, there was no need to correct the results obtained since the measurement of a variety of radioactive compounds with different counting efficiencies is not involved. It was shown that the plateau length, and hence the counting efficiency, is constant for mixtures containing 20 to 40% methane and 80 to 60% hydrogen. For exploratory measurements, combination of a continuous-flow cuvette with a methane continuous-flow counter proved useful. The cuvette is separated from the counting chamber by a thin window, so that as a result of the spatial separation of carrier and counting gas, the results measured are relatively independent of the nature of the carrier gas. Several other experimental arrangements are described, one which permits discontinuous measurement of $^{14}CO_2$, and another, a continuous-flow proportional counting tube for continuous measurements, especially with hydrogen as carrier gas. Using hydrogen as carrier gas and (with admixture of about 10% of methane) as counting gas, the background effect of this counting tube lies under 100 impulses/min and becomes less with increasing additions of methane. The counting rate is substantially constant for methane contents of more than 30%. The plateau curves for selected hydrogen/methane mixtures, measured using a constant radiation source, are shown. A plot of different hydrogen/methane ratios in the gas mixture against the plateau length shows the optimum ratio (80 to 60% H_2; 20 to 40% CH_4). Some applications of radio- and reaction gas chromatography are described: using the first experimental arrangement, mentioned above, investigations were made of the ^{14}C-labeled alcohols arising from fermentations in the presence of added ^{14}C-glutamic acid; fatty acids were analyzed after being converted into their methyl esters by treatment with boron trifluoride and methanol; saponification of $K^{14}CN$ to ^{14}C-

formate was investigated to determine whether the reaction goes to completion and whether there are volatile by-products; other problems, including transesterification, $^{14}CO_2$ assimilation by plants, and efficiency of hydrogenation catalysts. (BBB)

17943 INVESTIGATION OF THE SORPTION OF URANIUM ON THE MINERALS OF THE SURROUNDING ROCKS. G. M. Alkhazashvili, B. V. Nevskii, and I. I. Arkharova. At. Energ. (USSR), 16: 51-5(Jan. 1964). (In Russian)

During the hydrometallurgical treatment of U ores, a certain portion of the U is lost on the solid tailings. Although it was assumed that these losses are due to sorption of the U on the surface of the mineral particles, there was no experimental evidence to support this view. Tests were therefore carried on the sorption mechanism of U during the leaching treatment on montmorillonite, kaolinite, bauxite, hydrated mica, and albite; these minerals are weak adsorbers with their sorptive capacity decreasing in the above-given order. The effect of time of contact, pH, concentration of the solution, and temperature on the sorption mechanism was investigated. It was found that at a U and H_2SO_4 concentration of 0.24 to 0.26 and 9 to 12 g/liter, respectively, the sorption capacity increases with time, reaching in 30 minutes 0.35, 0.3, and 0.1 mg. equivalents/100 g of the mineral, for the montmorillonite, kaolinite, and bauxite, respectively. A further increase of the time of contact reduced somewhat the capacity of the montmorillonite; that of the kaolinite was reduced sixfold while that of albite approached zero. The sorptive capacity of the minerals was lowest at pH ranging from 0.5 to 1; a considerable increase was noted at pH = 4. The temperature had a positive effect as it was increased from 20 to 50°C and a negative effect upon further increase to 80°C. Sulfate, nitrate, and chloride solutions desorbed the U from the surface of the solids. Inasmuch as the sorption is an ion exchange reaction, the extraction of U from clay minerals may be improved by using ion exchange resins. (TTT)

17944 EXTRACTION OF $[UO_2(CO_3)_3]^{-4}$ IONS FROM DILUTE SOLUTIONS BY MEANS OF FROTH. Carla Iacobelli Turi, Alberto Barocas, and Franco Salvetti (CNEN, Rome). Gazz. Chim. Ital., 93: 1493-1502(Nov. 1963). (In Italian)

A method was devised for concentrating U(VI) from dilute carbonate solutions by means of ion flotation. The method is based on an absorption mechanism of the anionic uranyl tricarbonate complex on the frothing agent, having opposing charges. The absorbed material becomes separated from the solution by means of the current of gas that causes the formation of a froth, which is then collected. It was possible, starting with a solution containing 12 mg of $UO_2(NO_3)_2 \cdot 6H_2O$ in 150 ml of solution, to concentrate that quantity of uranium in 1-2 ml of broken-down foam. (tr-auth)

17945 SEPARATION OF ZIRCONIUM AND HAFNIUM BY THE METHOD OF PAPER CHROMATOGRAPHY. Shih-fu Tsou and Pei-li Tao. Hua Hsueh Hsueh Pao, 28: 344-6(1962).

The method of paper chromatography in mixtures of tri-n-butyl phosphate–n-C_4H_9OH–$C_6H_4(CH_3)_2$ (or C_6H_6), saturated with 8–10 N HNO_3 with various ratios of the components, was used for the quantitative separation of Zr and Hf. (OTS)

17946 RECOVERY OF METAL AND EDTA CONTENTS FROM METAL-EDTA SOLUTIONS. T. R. Bhat and Y. W. Gokhale (Atomic Energy Establishment, Trombay, India). Indian J. Chem., 2: 105-7(Mar. 1964).

Recovery of EDTA from metal-EDTA complex solutions by different methods such as acidification, removal of metal ions by hydroxide, and precipitation as sulfide and oxalate is discussed from the theoretical point of view. Experimental data are presented for the recovery of EDTA and metal contents from rare earth; copper-, iron-, calcium-, cadmium-, lead-, and bismuth-EDTA solutions, employing these methods. (auth)

17947 EXTRACTION OF THORIUM FROM NITRIC ACID SOLUTIONS BY SOME CYCLOHEXYL- AND BENZYL-ALKYLAMINES. Taichi Sato (Government Chemical Industrial Research Inst., Tokyo). J. Appl. Chem. (London), 14: 41-6(Jan. 1964).

The partition of thorium between nitric acid solutions and the solutions of some cyclohexyl- and benzyl-alkylamines in benzene was investigated at different concentrations of nitric acid and solvent, and at different temperatures. The extraction of nitric acid by these amines in benzene was also examined. Further an infrared spectral study was made of the organic solutions obtained. The mechanism of thorium extraction in this system is discussed on the basis of the results obtained. (auth)

17948 DISTRIBUTION OF NITRIC ACID BETWEEN TRI-N-BUTYL PHOSPHATE AND WATER. P. E. Burns and C. Hanson (Bradford Inst. of Tech., Bradford, Yorks, Eng.). J. Appl. Chem. (London), 14: 117-21(Mar. 1964).

The distribution of nitric acid between water and both 20 and 30% v/v solutions of tri-n-butyl phosphate in odorless kerosene at 20 and 25°C was studied systematically up to aqueous phase concentrations of 10 moles per liter. An equation was derived to represent the distribution up to aqueous phase concentrations of 4 moles per liter. (auth)

17949 INORGANIC THIN-LAYER CHROMATOGRAPHY. A. Moghissi (Kernforschungzentrum, Karlsruhe, Ger.). J. Chromatog., 13: 542-8(Feb. 1964). (In German)

Some binary and multiple separations of radiochemical interest were carried out by means of thin-layer chromatography. The chromatograms were evaluated automatically by a radiation counter. Lanthanum oxide was used successfully besides the usual thin layers. (auth)

17950 THE SEPARATION OF PLUTONIUM FROM URANIUM AND FISSION PRODUCTS ON ZIRCONIUM PHOSPHATE COLUMNS. Ivan Gal and Aleksandar Ruvarac (Inst. of Nuclear Science "Boris Kidrich," Belgrade). J. Chromatog., 13: 549-55(Feb. 1964).

A procedure for the separation of plutonium from uranium and long-lived fission products on zirconium phosphate columns is described. Traces of plutonium are separated from nitric acid solutions containing a few grams per liter uranium. Data such as the distribution coefficients, plutonium recovery, and decontamination factors are presented. (auth)

17951 THE EXCHANGE CAPACITY OF PAPERS IMPREGNATED WITH ZIRCONIUM PHOSPHATE. Giuliana Grassini and Claudia Padiglione (CNEN, Rome and CNR, Rome). J. Chromatog., 13: 561-4(Feb. 1964).

Papers containing zirconium phosphate were prepared and the chromatographic behavior of UO_2(II) and Pb(II) was studied. Chromatograms were performed at four different temperatures: 5, 20, 35, and 50°C. R_F values were found to vary considerably with the number of washes of the paper. For example UO_2^{2+} developed with 1 N $HClO_4$ had an R_F value of 0.6 on a 5% paper after three washes and of 0.8 after seven washes. On a 30% paper the R_F value was 0.2 after three washes and 0.4 after seven washes. The temperature variation between 5 and 50°C was not very considerable, somewhat higher R_F values being observed in all

cases at higher temperatures. However, there seems to be no definite advantage in working at any specific or at a rigidly controlled temperature. Data are tabulated. (P.C.H.)

17952 COMPARISON OF THE REMOVAL OF RADIOSTRONTIUM FROM IN VIVO AND IN VITRO LABELED MILK FROM ION-EXCHANGE RESINS. L. F. Edmondson, D. H. Keefer, F. W. Douglas, Jr., J. Y. Harris, and E. Dodson (Dept. of Agriculture, Washington, D. C.). J. Dairy Sci., 46: 1362-6(Dec. 1963).

In exploratory studies prior to development of a pilot plant process for removal of ^{90}Sr from milk, the feasibility of substituting ^{85}Sr for ^{90}Sr and in vitro for in vivo labeling of milk was investigated. Advantages of use of ^{85}Sr rather than ^{90}Sr are that the latter is tedious and time-consuming to determine analytically, environmental levels of ^{90}Sr are too low to obtain the accuracy desired for research and development purposes, and ^{85}Sr is a γ-emitter and can be assayed rapidly without sample preparation. Because of the convenience and economy of using in vitro labeled milk it is preferable to use this method, particularly when large quantities are needed. Thus studies were made to determine differences in the amount of radiostrontium removed by ion-exchange resins from milk labeled in vivo and in vitro with ^{85}Sr or ^{90}Sr, or both. The distribution of ^{85}Sr and Ca between phases of centrifugally fractionated milk was also studied. The milks were adjusted to pH levels as low as 5.2 with citric acid before passing through ion-exchange columns, and before centrifuging. The amount of Sr removed varied from about 95% at pH 5.25 to 45% at pH 6.65 for in vivo labeled milk. The amounts for in vitro labeled milk were only slightly higher at low pH, but ranged from 79 to 50% at pH 6.65, for equilibration times of 30 min and 120 hr, respectively, before resin contact. Portions of milk labeled in vivo with ^{85}Sr were centrifuged at 105,000 X g for 90 min. The amounts of Sr in the serum were 86, 46, and 19%, respectively, of pH levels of 5.2, 5.8, and 6.6. Corresponding Ca levels were 84, 59, and 33%. Most of the remainder was in the sediment. Less than 1% was recovered in the fat layer. The data show that considerable time is required for dissolved Sr (in vitro added) to bind with the colloidal or other milk constituents. The extent of removal (percentage wise) of environmental ^{90}Sr (e.g. 10 μμC/liter), and of tracer levels of ^{85}Sr (1 μC/liter) will be the same as long as the method of incorporating them into milk is the same, since both levels are many orders of magnitude less than the stable (natural) Sr content. (BBB)

17953 ON THE CO-SEPARATION STUDY OF ACID-INSOLUBLE PYROPHOSPHATES OF RARE ELEMENTS. B. C. Purkayastha and K. N. Dutta (Saha Inst. of Nuclear Physics, Calcutta). J. Indian Chem. Soc., 40: 1025-8(Dec. 1963).

Distribution studies with ^{46}Sc and UX_1 as guest ions and Ce(IV) and Zr as host components showed that both Ce(IV) and Zr take up scandium and UX_1 (thorium) through mixed crystal formation when the hosts are precipitated as pyrophosphate. In all cases the study was extended from tracer level to finite concentration of the tracer ion. In the case of scandium, an attempt was made to find out the limiting concentration of the tracer ion. It was observed that up to the limiting concentration of the guest ion, λ values remain constant, but beyond it λ value, though constant at a particular concentration, assumes a diminishing trend as the concentration of the guest ion is increased. Data are discussed in the light of previous observations. (auth)

17954 CONTROL OF PULSE COLUMNS FOR NUCLEAR FUEL PROCESSING. Yomei Kato (Hitachi Ltd., Tokyo). J. Japan Assoc. Autom. Control Engrs., 7: 525-34(Sept. 1963). (In Japanese)

Control systems for pulse columns, the vital part of reactor fuel reprocessing plants, were studied. Good agreement was obtained in experimental and theoretical analyses of pulse-column dynamics. Pulse columns may be controlled by regulation of the interface level and by controlling the feed and solvent flow rates. The interface-level control system was analyzed in detail using an analog computer, since experiments indicate that the raffinate flow rate can be regulated by the interface-level signal. The flow-rate control system is useful in the maintenance of extraction performance. (from NSA of Japan)

17955 CALCULATION OF THE EXTRACTION OF THE TRINITRATO COMPLEXES OF NITROSYLRUTHENIUM IN THE PRIMARY SEPARATION PLANT OF REACTOR FUEL PROCESSING. [PART] I. M. Takigishi (Atomic Fuel Corp., Tokyo). J. Nucl. Energy, Pt. A & B, 18: 67-79(Feb. 1964).

Differential equations based on the kinetics of the interchange between organic and aqueous phase were developed for the computation of counter-current stripping and extraction of the trinitrato complexes of nitrosylruthenium. Application of the solutions obtained in the process should be capable of satisfactorily accounting for the performance of a mixer-settler system, and it is also suggested that the mixing time should be based on these results in order to give the optimum change of concentration in each section. It is also possible to analyze the ruthenium recycling in the extraction section and the feed stage as previously suggested. (auth)

17956 PREPARATION OF HIGH PURITY THORIUM OXIDE. REFINING IN THE TBP-THIOCYANATE SYSTEM. Keikichi Nakamura (National Research Inst. for Metals, Tokyo). Kinzoku Zairyo Gijutsu Kenkyusho Kenkyu Hokoku, 6: No. 1, 25-31(Mar. 1963). (In Japanese)

Solvent extraction of Th in the TBP-$Th(NO_3)_4$ system does not exhibit high extraction efficiency. Therefore the TBP-NH_4CNS-$Th(NO_3)_4$ system was studied to determine its efficiency in the extraction and purification of Th from rare-earth metals. With optimum conditions, the rare-earth oxides in a $Th(NO_3)_4$ solution could be decreased from 43% using TBP to 13 ppm using TBP-NH_4CNS with a 1.5% loss of Th in 1 extraction and 3 scrubbing stages. Optimum conditions were: for extraction, TBP 20 vol % in kerosene, $NH_4CNS/Th(NO_3)_4$ = 4, 0.1N $Th(NO_3)_4$, pH = 2, organic/aqueous = 1, 1 stage; for scrubbing, 0.1N NH_4CNS, organic/aqueous = 1, 3 stages; and for stripping, 1.2N H_2SO_4, organic/aqueous = 1, 2 stages. In this system, it was confirmed that Th behaves in the form of $Th(CNS)_4$. (from NSA of Japan)

17957 THERMODYNAMICS FOR THE EXTRACTION OF URANYL NITRATE AND NITRIC ACID BY ORGANOPHOSPHORUS COMPOUNDS. Tomota Nishi and Mitsuru Asano (Kyoto Univ.). Kogyo Kagaku Zasshi, 66: 1428-33 (Oct. 1963). (In Japanese)

The thermodynamic quantities, ΔF, ΔH, ΔS, and ΔC_p for the extraction of uranyl nitrate and nitric acid by a series of organophosphoric compounds are obtained. The compounds are R_3PO, $(RO)R_2PO$, $(RO)_2RPO$, $(RO_3)PO$, and $(RO)_2HPO$, in all of which R is an n-butyl group. The substantial changes in ΔF and ΔH are shown as replacing an n-butyl group successively by an n-butoxy group. The values of ΔS for the uranyl nitrate extraction remain approximately at a constant of −8 to −9 eu, irrespective of the types of extractants and their diluents, but those

of ΔS for the nitric acid extraction vary from +1 to −38 eu, depending on the diluents used. When the values of ΔH for the extraction of uranyl nitrate are plotted against the values of ΔH for the extraction of nitric acid in a series of extractants, a straight line is obtained. It is also shown that there is a linear relationship between the values of ΔH and the stretching frequencies of the phosphoryl group of the extractant, which is bonded with uranyl nitrate or nitric acid. The values of ΔF_0, ΔH_0, and ΔS_0 are calculated by extrapolating both the ionic strength in an aqueous phase and the concentration of tri-n-butyl phosphate in an organic phase to zero. (from NSA of Japan)

17958 CATION EXCHANGE SEPARATION OF ALKALINE EARTH ELEMENTS WITH HYDROCHLORIC ACID CONTAINING METHANOL. Masaya Tanaka (Tottori Univ., Tachikawa, Japan). Nippon Kagaku Zasshi, 85: 117-19(Feb. 1964). (In Japanese)

Ion-exchange separation of Mg, Ca, Sr, and Ba with HCl containing methanol as eluant was studied. Exchangers used were Amberlite IR-120, Diaion SK # 1, Dowex 50-X1, and Dowex 50W-X8, each having similar exchange capacity except Dowex 50-X1. As the methanol content of the eluant increased from 0 to 20 vol%, the rate of elution was lowered. Furthermore, the higher the atomic weight of alkaline earth element, the greater the effect of methanol on the rate of elution became. Using this effect of methanol, alkaline earth elements such as Mg, Ca, Sr, and Ba can be separated more sharply than the case where hydrochloric acid alone is used. For example, when Dowex 50W-X8 is used as an exchanger Mg is separated from Ca with 0.7 N HCl or with 0.8 N HCl containing 10% methanol, Ca from Sr with 0.8 N HCl containing 20% methanol, and Sr from Ba with 1.2 N HCl, respectively. In the case of Dowex 50-X1, the effect of methanol addition to HCl on the separation of these elements was not so remarkable, because of its low specific exchange capacity. (auth)

17959 CATION EXCHANGE SEPARATION OF ALKALINE EARTH ELEMENTS, Al AND Fe WITH FORMATE BUFFER SOLUTION CONTAINING METHANOL. Masaya Tanaka (Tottori Univ., Tachikawa, Japan). Nippon Kagaku Zasshi, 85: 119-22(Feb. 1964). (In Japanese)

The ion-exchange separation of Mg, Ca, Sr, Ba, Al, and Fe with the buffer solution of formic acid and ammonium formate containing methanol was studied. The exchanger used was Dowex 50W-X8. Addition of methanol to an eluant of formate buffer solution slows down the elution rate of alkaline earth elements. The result is similar to that obtained previously in the case of hydrochloric acid. The heavier the atomic weight of alkaline earth elements and the lower the pH of formate buffer solution, the slower the elution rate becomes. Little effect of methanol was observed in the case of Al, which was separated at lower pH, and a slightly larger rate of elution was obtained. This effect could not be found as regards Fe, which has the largest of all the elution rate. The cation exchange separation of these six elements can be accomplished satisfactorily utilizing the experimental fact mentioned above. For example, Fe, Al, and Mg were separated successively with formate buffer solution of pH 3.5 containing 10% methanol, Ca with that of pH 4.9 containing 10% methanol, Sr with that of pH 6.0, and finally Ba with 1.5 mole/l ammonium formate. (auth)

17960 SEPARATION OF TECHNETIUM FROM MOLYBDENUM BY SOLVENT EXTRACTION. Yoshinaga Oka and Toyoaki Kato (Tohoku Univ., Sendai). Nippon Kagaku Zasshi, 85: 128-32(Feb. 1964). (In Japanese)

The solvent extraction behavior of molybdenum and tracer amount of technetium, from aqueous hydrochloric acid or from aqueous acidic thiocyanate solution, by diethyl ether, methyl-isobutyl ketone, and tri-n-octyl amine dissolved in cyclohexane was investigated. The procedure for the preparation of carrier-free technetium activity from neutron irradiated MoO_3 target was established. In HCl-NH_4NCS aqueous systems, both molybdenum(VI) and technetium(VII) were reduced with excess thiocyanate and formed their thiocyanate complexes at the same time exhibiting their maximum absorbancy at 462 mμ and 505 mμ, respectively, and the complexes were extractable with the above extractants. Liquid amine was especially efficient in the distribution of the complexes. When molybdenum was extracted by diethyl ether from 1 M HCl − 1 M NH_4NCS solution of neutron irradiated MoO_3 target, radiochemically pure ^{99m}Tc was obtained in aqueous solution with final yield of about 80%. (auth)

17961 DIFFERENCES IN THE REMOVAL OF ACTIVITY FROM AN IRRADIATED THORIA/URANIA SLURRY AND FROM A SLURRY CONTAINING ADSORBED ACTIVITY. Robert H. Rainey (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng., 18: 530-1(Apr. 1964).

A method previously suggested for chemical reprocessing and purification of thoria–urania slurry type reactor fuels was tested in an in-pile loop experiment. Less than 1% of the gross gamma activity due to fission products was removed from the slurry by leaching with 6 M HNO_3 (100°C) for 6 hours. The experiment demonstrates that simple acid leaching can not be used to decontaminate irradiated thoria slurries for recycle. (C.E.S.)

17962 PHYSICS CALCULATIONS FOR THE PHILIPPINE OPENPOOL REACTOR PRR-I. C. REACTOR CONTROL. Jose O. Juliano and Cesar L. Pineda (Philippine Atomic Energy Commission, Manila). Philippine J. Sci., 92: 329-40(Sept. 1963).

Methods based on neutron diffusion theory were used to calculate the blade control-worths for the four control blades of PRR-I. (R.E.U.)

17963 PROCESS FOR SEPARATING MIXTURES OF SUBSTANCES. (to Deutsche Gold-und Silber-Scheideanstalt Vormals Roessler). British Patent 954,251. Apr. 2, 1964. Priority date Sept. 16, 1960, Germany.

A process is described for separating Zr and Hf by two-phase liquid-liquid partition. The process comprises feeding the solid crude mixture directly into the middle position of a Van Dyck partitioning system with HSCN–H_2O and HSCN–methyl isobutyl ketone phases, and withdrawing the purified Zr from one end of the system. The introduction of the solid mixture, rather than a previously prepared solution, into the partitioning system prevents the formation of inextractable polymeric compounds and thus results in a more pure product. Examples of the process are given in which a Zr product containing 0.0003% Hf was obtained, as compared to 0.01 to 0.05% Hf obtained using previously prepared solutions. The process may also be applied to the separation of Nb and Ta. (D.L.C.)

17964 DEVICE FOR THE DETECTING OF FRAGMENTS OF THE α CLADDING OF NUCLEAR FUEL ELEMENTS. (to Commissariat à l'Energie Atomique). French Patent 1,315,918. Dec. 17, 1962. Filed Dec. 14, 1961.

The decladding of nuclear fuel elements is often performed in tanks associated with swimming pool reactors. The fragments of the cladding are usually removed from the tank via a waste pipe. It is important that only one fragment passes at the same time so that the waste pipe does not get jammed. A device was designed to provide

a method for the operator to detect the passage of a fragment at two detecting points at both ends of the pipe. At each detecting point a measuring condenser is provided, comprising two cylinders disposed, with an appropriate distance from each other, around a part of the waste pipe made of insulating material. The device comprises two oscillating circuits, the frequency of one of them being influenced by the measuring condenser. These oscillating circuits are connected to the grids of two triodes having the same anode circuit. This assembly furnishes a signal, the modulation frequency of which depends on the capacity of the measuring condenser, that is, it changes during the passage of a cladding fragment. (IIB)

17965 PROCESS FOR SEPARATING ZIRCONIUM AND HAFNIUM VALUES. Kurt Peters. U. S. Patent 3,127,236. Mar. 31, 1964. Priority date Apr. 27, 1956, Austria.

A process for separating Zr and Hf is given which is based on the fractional precipitation of the oxalato complex ions of Zr and Hf. The preparation of the oxalato complex comprises converting the ore to phosphates, treating the phosphates with an amount of oxalic acid just sufficient to peptize the phosphates, adding a second amount of oxalic acid about equal to the first amount to convert the colloidal material to a phosphato oxalato compound, and maintaining the solution at water bath temperature (40 to 60°C) until the phosphate ions in the compound are replaced by oxalate ions. The solution is then subjected to fractional precipitation by mineral acid solutions under homogeneous conditions. Two examples of the process are given. (D.L.C.)

17966 METHOD OF EXTRACTING PROTACTINIUM FROM URANIUM ORES. B. F. Myasoedov and E. S. Pal'shin. Russian Patent 157,784.

Protactinium is extracted from uranium ores by leaching with acids and subsequent separation of protactinium from the solution. To obtain a high-purity metal and to accelerate the process, protactinium is isolated by extraction with isopentyl alcohol in the presence of Arsenazo III and sulfuric acid. (OTS)

ENGINEERING

General

Refer also to abstract 18282.

17967 (CONF-449-2) OBTAINING AND DEMONSTRATING RELIABILITY IN ELECTROMECHANICAL COMPONENTS IN NUCLEAR WEAPONS SYSTEMS MANUFACTURED FOR THE ATOMIC ENERGY COMMISSION. Lawrence E. Killion (Albuquerque Operations Office, AEC). [nd]. 13p.

From Institute of Electrical and Electronics Engineers National Aerospace Electronics Conference, Dayton, Ohio, May 1964.

The Atomic Energy Commission places maximum responsibility on its contractors for the design, development and manufacture of nuclear weapons systems. Basic military characteristics for nuclear weapons systems including certain physical and performance features are developed by the Department of Defense and given to AEC as Military Characteristics (MCs) which include basic reliability requirements. On the basis of the MCs the AEC design agencies prepare specifications including the detailed quality and reliability specifications. The design specifications are provided to AEC manufacturing contractors who have the responsibility to produce the nuclear weapons systems in accordance with the specifications. The AEC requires its manufacturing contractors to maintain an effective quality control (QC) program that will provide product quality consistent with specifications and design intent. In addition to the manufacturers' QC program, the AEC has a Quality Assurance (QA) program which is an audit type function. The QA function is a streamlined effort designed to give assurance to the AEC and, in turn, to the DOD that the AEC manufacturers' QC programs are effective and the quality of nuclear weapons systems going into War Reserve (WR) Stockpile is satisfactory. The manufacturers' QC efforts and not the AEC QA program are the principal tools used to maintain quality in the manufacturing process. Furthermore, it is the manufacturing contractors who influence the level of the QA effort since the degree of AEC inspection and other audit effort is tempered by the effectiveness of the contractors' QC programs. The ideal evaluation of the quality of the stockpile would, of course, consist of taking a statistically valid sample from the stockpile and having a complete functional test. In the absence of this, the next best thing is the results of the New Materials System Tests (NMST)—Stockpile Sampling Program (SSP) which is a part of the AEC Quality Assurance effort. Sample sizes are selected from new production and from the stockpile and on the basis of inspections and tests a functionability statement is made at a specified confidence level. Short of taking a statistically valid sample from the stockpile and having full scale detonations, the best single indicator of the quality of AEC produced nuclear weapons systems in the stockpile is the results of the NMST-SSP program. Some examples are given to illustrate how reliability is specified, obtained, and demonstrated in electromechanical components. (auth)

17968 (NP-13769) DESIGN, FABRICATION, AND TESTING OF A CESIUM ION ROCKET ENGINE. SUMMARY REPORT. PHASE III. (Hughes Aircraft Co. Hughes Research Labs., Malibu, Calif.). Mar. 18, 1964. Contract NAS 5-517. 599p.

Research and accomplishments in the cesium contact in thrustor program and related areas from September 1962 to October 1963 are described in detail. Engine fabrication and testing, application studies, experimental facility development, and development and fabrication of materials and components are covered. Among the more notable achievements, the problems encountered in integrating the SERT-1 engine and power conditioning subsystems were largely solved. Also, studies indicated the superiority of the linear strip engine configuration, and a compact strip engine module design was developed. Preliminary life tests with the Model 3C circular ring engine were encouraging. (D.C.W.)

17969 (SB-410(Suppl.1)) BEARINGS. (Office of Technical Services, Washington, D. C.). Sept. 1963. 17p.

Approximately 140 references are presented to reports listed in U. S. Government Research Reports and Technical Translations. The references are arranged under the following headings: gas-lubricated bearings, plastic and ceramic bearings, ball bearings, journal bearings, roller bearings, general, and government-owned patents. (D.L.C.)

Applications of Nuclear Explosions

17970 (SC-RR-64-19) JANGLE TRUE CRATER MEASUREMENTS. L. J. Vortman (Sandia Lab., Albuquerque, N. Mex.). Feb. 1964. Contract AT(29-1)-789. 10p.

True crater depths of the Jangle Surface crater and the Jangle Underground crater were determined by excavation. They were, respectively, between 17 and 19 feet and between 65 and 66 feet. One radius of the true crater of the Jangle Surface shot was excavated, and found to be approximately 60 feet, 14% more than the apparent crater at that point. There was no measurable fallback in the bottom of the Jangle Surface crater, indicating that true and apparent crater depths were the same. (auth)

17971 (UCRL-7658) NUCLEAR EXCAVATION TECHNOLOGY. Milo D. Nordyke (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 10, 1964. Contract W-7405-eng-48. 24p. (CONF-461-1)

From Highway Research Board 43rd Annual Meeting, Washington, D. C., Jan. 1964.

Large scale excavation is perhaps the most obvious and straightforward use of nuclear explosives. The size of the excavation depends on several factors, such as the explosive yield, medium, and depth of burst. Considerable knowledge has been obtained over the last several years on the cratering effect of chemical and nuclear explosives in a variety of media. Further, it has been shown that several explosives, spaced about a single crater radius apart and detonated simultaneously, will produce a uniform channel with a width and depth approximately equal to single crater dimensions. Such a channel may be used for applications such as waterways and railroad and highway cuts. Burial of the nuclear explosive at such a depth that almost maximum dimensions are obtained results in trapping over 90% of the radioactivity underground. This entrapment, when combined with the use of nuclear explosives in which a very small fraction of the energy comes from fission processes, allows nuclear excavation to be used in remote areas with complete radiological safety. Presently published costs for nuclear excavation

indicate that the unit cost of excavation decreases with increasing depth of excavation. In general, nuclear excavation is economical for depths greater than about 100 ft. It is anticipated that future technological development and mass production of nuclear explosives will substantially reduce present published device costs. (auth)

17972 APPARATUS FOR CREATING STRONG MAGNETIC FIELDS. Miroslav Litomisky. Vestn. Cesk. Akad. Ved, 72: 594-5(1963).

A brief description of the design and operation of the 650-kw solenoid is given. The intensity of the constant magnetic field is 48 kilogauss. Plans for building additional solenoids, some of them even stronger, are discussed. (OTS)

Facilities and Equipment

17973 (APDA-163) OPERATION OF THE SODIUM TECHNOLOGY LOOP FOR CONTAMINATION METER EVALUATIONS. (Atomic Power Development Associates, Inc., Detroit). Mar. 25, 1964. Contract AT(11-1)-865. 120p.

The Blake Rhometer operating range was extended from 600 to 1000°F and a variable-orifice plugging meter was developed. Both instruments were evaluated in the Atomic Power Development Associates Sodium Technology Loop against weighed or metered contaminants. The loop injection series included: water, hydrogen, carbon monoxide, carbon dioxide, and methane gases; and tea bag injections of sodium carbonate, sodium hydride, sodium hydroxide, and sodium monoxide. Cover gas was monitored and temperature varied during and after each injection run, and the test loop cleaned by cold trapping after each run. A Continuous Hydrogen Monitor attached to the loop cover gas system and a Nickel Diffusion-Tube Hydrogen Monitor connected to the loop proper were evaluated for sensitivity and response. (auth)

17974 (BW-67-1) SODIUM-HEATED STEAM GENERATOR DEVELOPMENT. Interim Status Report. (Babcock and Wilcox Co., Barberton, Ohio). Jan. 22, 1964. Contract AT(11-1)-1280. 36p.

Design and development of a once-through sodium-heated steam generator are discussed. Research proposals are discussed for evaluating: carbon transfer and mass transfer effects in the steam generator, effect on heat transfer and two-phase flow of coiling tubes, corrosion of Croloy 2¼ in products of sodium-water reactions, procedure for welding tube to back side of the tube sheet, radiographic inspection of back side tube welds, and chemical simulation of sodium environment for leak testing. (N.W.R.)

17975 (HW-77912(Rev.)) THE EFFECT OF HOLES ON THE PERFORMANCE CHARACTERISTICS OF HIGH-EFFICIENCY FILTERS. F. E. Adley and D. E. Anderson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 1963. Contract AT(45-1)-1350. 22p.

Descriptions are given of how damage to air filters of the high-efficiency fibrous type alters their efficiency in a characteristic manner. The integrity of a high-efficiency air filter was appraised by measuring the change in penetration as affected by a change in air-flow. The tests demonstrated that penetration varied directly as the airflow for filters of good integrity and inversely for filters containing defects. The difference in airflow through a hole and a filter medium resulting from a given change in pressure drop was demonstrated to account for a characteristic performance in good filters and those containing defects. A semi-quantitative relation was found between the penetration level of a filter and the size of any breaks or defects that permit the passage of unfiltered air. (P.C.H.)

17976 (KFK-176) LABORATORIEN FUR ARBEITEN MIT RADIOAKTIVEN STOFFEN. BIBLIOGRAPHIE UBER PLANUNG, BAU, EINRICHTUNG UND AUSRUSTUNG. TEIL II. (Laboratory for Work with Radioactive Material. Bibliography on Design, Construction, Arrangement, and Equipment. Part II). G. Brossmann (Kernforschungszentrum, Karlsruhe, Germany). Oct. 1963. 99p.

Four hundred and twenty references on the construction, planning, arrangement, and equipment of laboratories for work with radioactive materials are presented, covering the period 1956 to October 1963. (M.C.G.)

17977 (ORNL-TM-793) SOME DEVELOPMENTS IN ENGINEERING, FABRICATION, AND FIELD SUPPORT OF LABORATORY PROGRAMS. REPORT III, APRIL 1963–SEPTEMBER 1963. H. E. Seagren (Oak Ridge National Lab., Tenn.). Mar. 1964. Contract W-7405-eng-26. 40p.

Development work in finding solutions to problems of inspection to close tolerances, reducing cost in terms of manpower, and time for repetive operations, and applying containment principles to the transfer of materials and equipment into and out of hot cells is discussed. The presentation consists of an indication of a problem, a summary of the procedure, and technique, or equipment used to solve the problem. An index of problems is included. (P.C.H.)

17978 (AEC-tr-6379) POLYPHASE ANNULAR ELECTROMAGNETIC INDUCTION PUMPS FOR LIQUID METALS. E. Cambillard (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). Translation of paper presented at the "Colloquim of the European Society of Atomic Energy [on Liquid Metal] Aix-en-Provence, Cadarache, France, September 30 to October 2, 1963." 35p.

Polyphase annular electromagnetic induction pumps can be designed such as to be interchangeable with free-surface centrifugal mechanical pumps with equivalent performance. Two pumps of this type are described and the results of tests conducted are presented after the review of the design of a prototype of a non-immersible annular electromagnetic pump which permitted the development of production and installation techniques. (auth)

17979 (AEC-tr-6383) THEORY OF ANNULAR ELECTROMAGNETIC PUMPS AND COMPARISON WITH EXPERIMENTS. B. Schwab (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). Translation of paper presented at the "Colloquim of the European Society of Atomic Energy, on Liquid Metal, Aix-en-Provence, France, September 30–October 2, 1963." 64p.

The method of end coefficients for calculating the pressures and losses of electromagnetic pumps is presented. The bases of this method are then used to formulate a method that takes into account both the imbalance of currents and any winding. The flux is determined and is used to derive the pressures and losses. This new method is well verified by tests on the C1P pump in the Rapsodie reactor test loop and appears more complete than the Blake method. (D.C.W.)

17980 HIGH INTENSITY RADIATION DEVELOPMENT AT BROOKHAVEN. Atomics, 17: 26-9(Mar.-Apr. 1964).

The development and proposed uses of the High Intensity

Radiation Development Laboratory (HIDRL) are discussed. The preparation and irradiation cells are described. (R.E.U.)

17981 CONSTRUCTION OF A TRANSFORMER WITH SUPERCONDUCTING WINDINGS. Alain Mailfert and Gerard Fournet (Faculte des Sciences, Fontenay-aux-Roses, France). Compt. Rend., 258: 2271-4(Feb. 24, 1964). (In French)

The specific power and the losses of a transformer with superconducting windings were analyzed. An improvement of the specific power by a factor of about 200 over that of a transformer with conventional windings is indicated. A small transformer with Nb–Zr windings in a liquid He bath was constructed. The electrical efficiency for a transmitted power of 2 kw was greater than 99% with a power loss in the He of 0.4 w. (D.C.W.)

17982 EQUIPMENT OF THE VERY HIGH ACTIVITY ALPHA, BETA, GAMMA LABORATORY AT SACLAY. Jean Hainzelin, Alain Tarbe de Saint-Hardouin, and Andre Valentin. Ind. At., 7: Nos. 11-12, 49-61(1963). (In French)

The alpha, beta, gamma laboratory at Saclay was constructed for physical, metallurgical, and technological studies on irradiated plutonium fuel elements. The laboratory is briefly described, and a detailed account is given of the equipment, particularly pneumatic and electric remote-control devices and instrumentation and machinery. (P.C.H.)

17983 CONTROLLED ATMOSPHERE CHAMBER (Engineering Materials). (California. Univ., Berkeley. Lawrence Radiation Lab.). (CAPE-506)

The chamber is used in emission spectroscopy of radioactive elements. The vacuum-tight chamber is positioned around the arc spark during excitation to keep radioactivity from escaping and contaminating the glove box. The lid is fastened to the base by a quarter-turn breech thread. A rubber "O" ring is used to secure a good vacuum connection. Vertical motion of the electrode holders is through brass bellows in the base. During operation of the chamber, air is moved by a vacuum pump at about 2.5 cfm. Seventeen drawings are included. (F.S.)

17984 SHEFFIELD ROTARY CONTOUR GAGE (Engineering Materials). (California. Univ., Livermore. Lawrence Radiation Lab.). (CAPE-598)

The contour gage has an accuracy of 50–150 microinches on wall thickness and 100–300 microinches on radial distance. Run time is about 45 min for 45 points. The gage has 4 coordinate motions, a 90° angle θ, a 360° rotary angle ϕ, a radius setting "R," and a thickness setting "T." The radius and thickness slides are counter-weighted and have two inches of slide travel controlled by large diameter micrometer heads. Differential transformer gage heads show deviation from true position on radial distance and wall thickness. The gage may be used with a fringe counting interferometer as the ultimate displacement transducer as fringe counting lends itself to the two-inch slide travel of this gage. Combining a Sheffield Rotary Contour Gage, an interferometer, and a tape control servo system may provide a system that would make an inspection gage, of the speed and accuracy needed for modern machine tools. Twenty-nine drawings are included. (F.S.)

17985 IGNITRON PULSE TRANSFORMER (Engineering Materials). (California. Univ., Livermore. Lawrence Radiation Lab.). (CAPE-638)

The transformer is designed to couple the firing pulse to the igniter of an ignitron, which is used as the main discharge switch for a high voltage capacitor bank. The transformer provides polarity reversal and high voltage isolation between the firing pulse source and the igniter. The signal has a pulse amplitude of 3 kv, 3 to 5 μsec duration, and negative polarity. The output signal to the igniter is identical to the input signal because the transformer ratio is unity; however, the polarity is reversed to apply a positive pulse to the igniter. The transformer provides 20 kv isolation between the primary and secondary circuits and will handle peak pulse currents of 100 amps. The primary circuit of the transformer is provided with two spark plug protectors to divert possible fault currents to ground in the event of primary to secondary insulation failures. Nine drawings are included. (F.S.)

17986 CARBON-14 ISOTOPE SEPARATOR (Engineering Materials). (California. Univ., Berkley. Lawrence Radiation Lab.). (CAPE-914)

The isotope separator is a single-direction focusing spectrometer with a 90-degree sector magnet of 15 cm nominal radius of curvature. It is designed for the irradiation of solid samples with ions produced by gas discharge. The source gas is bled into the ionization source and ions are produced, extracted, and focused on a slit. Ions then enter the magnetic field, where they are separated, and the desired ions are allowed to pass though an exit slit and impinge upon the target material. The machine is used to study the C^{14}-ion irradiation of benzene to determine the chemical fate of the energetic radiocarbon species and the interactions of the energetic particle with its surroundings that led to that fate. Thirty-seven drawings are included. (F.S.)

17987 INTERMITTENT ROTOSLIDE SAMPLER (Engineering Materials). (Brookhaven National Lab., Upton, N. Y.). (CAPE-1093)

The rotoslide sampler utilizes the principles of the "rotorod" developed by Perkins and Leighton of Stanford University to efficiently impact large particles in the atmosphere independent of wind speed. The rotorod has two defects in terms of sampling aeroallergens. It is difficult to count the particles under a microscope and it is impractical for long-period utilization because an excessive number of particles reduces further collection. The rotoslide sampler utilizes the original principle of the Stanford development, but includes modifications that eliminate these difficulties. In the rotoslide, glass microscope slides are rotated by a drive motor at 1700 rpm. A cylindrical plastic shield is automatically raised to prevent spurious collection when the device is inoperative. The sampler can be used with an appropriate time cycle to obtain representative 24 hr samples without over-loading. The device was sufficiently successful to be submitted to the National Academy of Allergy as a possible substitute for the Durham slide collector as a standard pollen sampler. Twenty-four drawings are included. (F.S.)

17988 MODEL 503 AMPLIFIER (Engineering Materials). (Los Alamos Scientific Lab., N. Mex.). (CAPE-1110)

The amplifier is used in counting systems where medium-fast (<0.1 μsec) rise times are required. Clipping decay times of from 0.15 to 10 μsec can be supplied. The input and output are positive with linear amplitude to 60 v (100 v maximum) and a rise time of 0.06 to 0.14 μsec. Input shorted noise is 0.51 v p-p and input open, maximum gain is 0.55 v p-p. Using the 503-N preamplifier, input shorted shows a maximum gain of 3.6 v p-p. The panel is $8\frac{3}{4}$ in. by 19 in. with a chassis depth of 13 in. Nine drawings are included. (F.S.)

17989 IMPROVEMENTS IN OR RELATING TO MAGNETIC DRIVE SYSTEMS. Viggo Henning Sorensen (to United Kingdom Atomic Energy Authority). British Patent 953,066. Mar. 25, 1964. Filed May 25, 1960.

An electromagnetic clutch is designed which comprises a magnetic hysteresis coupling between coaxial driving and driven members separated by an air gap. The driving member is provided with two sets of interdigitating pole pieces extending in a radial direction from two rings of opposite polarity toward a portion of the driven member and which is formed of high magnetic hysteresis material. A fixed electromagnet is used to induce magnetism in the poles. Means is provided for detecting the onset of slip between driving and driven members. (D.L.C.)

17990 IMPROVEMENTS IN OR RELATING TO REMOTE CONTROLLED MANIPULATORS. Pierre Pesenti (to Commissariat à l'Energie Atomique). British Patent 953,468. Mar. 25, 1964. Priority date Aug. 31, 1959, France.

A terminal head of the knuckle joint type is designed in which means is provided for holding the cable stationary while the casing is rotated on the frame. The terminal head comprises a fixed frame, a casing and a wheel both mounted coaxially and rotatably on the frame, a terminal member mounted on the casing and movable radially on the wheel, and cylindrical guide members for holding the cable stationary and for guiding the cable as it leaves the head. (D.L.C.)

17991 IMPROVEMENTS IN AND RELATING TO LITTLE THRUST BEARING FOR THE SUPPORT OF ROTOR ROTATING WITH HIGH SPEED. (to Reactor Centrum Nederland). British Patent 954,073. Apr. 2, 1964. Priority date Mar. 17, 1960, Netherlands.

A pintle thrust bearing is designed for the support of a rotor rotating at high speed, e.g., in an ultracentrifuge. The rotor pintle is made of steel or other wear-resisting material and rests on the bottom of a recess in a guajakwood socket, and the socket resiliently grips the pintle over part of its length. The pintle may have a liquid drop shape, and the recess may have a similar shape so that the pintle is effectively restrained from jumping out of the socket. (D.L.C.)

17992 DEVICE FOR HEAT REMOVAL. (to Commissariat à l'Energie Atomique). French Patent 1,305,555. Aug. 27, 1962. Filed Aug. 23, 1961.

For the removal of heat from a heat source, e.g., a nuclear reactor, a series of entrance and exit headers for the cooling fluid is provided. The fluid from each entrance header goes through the heat source to an exit header supplying hot fluid to a heat exchanger. A method was developed in which the heat exchanger is connected to an entrance header of the heat source different from the entrance header which is connected inside the heat source to the exit header connected to the heat exchanger in question. In this way different regions of the heat source are connected in series with the corresponding heat exchangers. Each heat exchanger exit may supply cooling fluid to at least one circulation pump, while pumps and heat exchangers may individually be isolated from the circuit with the aid of bypass ducts and isolating valves. The arrangement has the advantage that in case of a rupture of a component, the effluent fluid is submitted to a flow resistance higher than that at usual arrangements where the heat exchangers are connected in parallel. (IIB)

17993 IMPROVEMENTS RELATING TO STEAM GENERATORS. (to Foster Wheeler Ltd.). French Patent 1,312,809. Nov. 12, 1962. Priority date Jan. 30, 1961, Great Britain.

Steam or vapor generators, especially for nuclear power plants, have a vertical cylindrical casing in which a bundle of U-shaped tubes is disposed, so that the two vertical branches of each tube communicate respectively with an entrance and an exit header disposed inside the casing. These tubes are used for the circulation of the heating fluid, while the interspace between tubes and casing is occupied by the boiling liquid. A method was developed so that the bundle could serve for both the development of steam and its superheating. For this purpose the cylindrical casing subdivided into three sections, the outer ones for the steam production and the center section for the superheating of steam formed in the two outer sections. This center section is separated from the other sections by an inner casing forming a passage for the steam to be superheated so that no superheated steam comes in contact with the outer casing. (IIB)

17994 IMPROVEMENTS RELATING TO HEAT EXCHANGERS. (to Société Francaise des Constructions Babcock and Wilcox). French Patent 1,313,183. Nov. 19, 1962. Filed Nov. 13, 1961.

Heat exchangers designed to work with fluids practically free from impurities, e.g., heat exchangers for nuclear reactor installations, are discussed. To increase the heat exchange coefficient the flow of at least one of the heat exchange fluids is led through a multiplicity of capillary channels provided in the heat exchanger structure so as to obtain an increased exchange surface. Preferably the heat exchanger structure comprises elements, enclosing tubes through which one of the exchange fluids passes, while the other one passes from one surface of the element to its opposite surface through capillary channels provided in regions of said structure. These regions are suitably constituted of sintered metal, of an assembling of metal gratings, etc. (IIB)

17995 IMPROVEMENTS RELATING TO HEAT EXCHANGERS. (to Commissariat à l'Energie Atomique). French Patent 1,322,236. Feb. 18, 1963. Filed Feb. 13, 1962.

For heat exchange between the two fluids of a heat exchanger, the cooling fluid being a liquid or gas while the cooled liquid is a gas, an improved process was developed consisting of the introduction of an auxiliary liquid into the stream of the gaseous fluid to be cooled and in the subsequent separation of this fluid. The auxiliary fluid, which is not submitted to an evaporation, is introduced at the entrance and is separated at the exit of the heat exchanger. This measure increases the heat transfer coefficient. A heat exchanger working according to this process may consist of a tube bundle inside which flows the fluid to be cooled, while the outer surfaces of these tubes are in contact with the cooling fluid. The entrance extremities of the tubes pass through an injection header from which this auxiliary fluid is introduced in the tubes via lateral holes provided in the tube walls. The injected quantity is controlled by means of an appropriated pump. (IIB)

Heat Transfer and Fluid Flow

17996 (AGN-8099) RUBIDIUM/CESIUM EVALUATION PROGRAM. FORCED CONVECTION BOILING OF RUBIDIUM AND CESIUM HEAT TRANSFER AND PRESSURE DROP. Final Topical Report. C. R. Fisher, L. T.

Clark, and J. H. Moskowitz (Aerojet-General Nucleonics, San Ramon, Calif.). Feb. 28, 1964. Contract AT(04-3)-368. 132p.

An experimental investigation was made of the heat transfer and pressure drop characteristics of Rb and Cs boiling in a smooth round tube. The experiments were performed in a niobium–1% zirconium alloy loop operated in an argon atmosphere at temperatures up to 1800°F. Sixty-six test runs were made with Rb and eighty-one with Cs. Operating parameters were varied to obtain information useful to designers of boilers for space power systems. Stable pressure and flow conditions were achieved in all test runs. Data on nucleate boiling heat transfer and critical, or burnout, heat flux are tabulated in the report. Critical heat flux is also plotted as a function of quality. A fog flow model is used to predict the critical heat flux, and reasonable agreement with the data is obtained. Pressure drop data are tabulated. The measured pressure drops are shown to fall below those predicted by the Lockhart-Martinelli correlation, but they agree well with a modified Kutateladze correlation. Ways in which the information may be used in designing liquid-metal boilers are described, and useful thermophysical property data on Rb and Cs are presented. (auth)

17997 (ANL-6796) THE SLUG-ANNULAR FLOW REGIME TRANSITION AT ELEVATED PRESSURE. Peter Griffith (Massachusetts Inst. of Tech., Cambridge; Argonne National Lab., Ill.; and Associated Midwest Universities, Lemont, Ill.). Nov. 1963. Contract W-31-109-eng-38. 23p.

The annular slug flow regime has been investigated in vertical upflow without heating through the use of an electrical conductivity probe. The Teflon cladding and seals of the probe were found to work to at least 488°F. When the inlet velocity was sufficiently high, the quality at transition was found to be a constant for each pressure going from 8.6% at 215 psia to 17.6% at 615 psia. No fully developed bubbly flow was observed. (auth)

17998 (DPST-64-83-2) USAEC–AECL COOPERATIVE PROGRAM MONTHLY PROGRESS REPORT, FEBRUARY 1964. H. S. Hilborn, comp. (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Mar. 19, 1964. Contract AT(07-2)-1. 25p.

Effect of Rod Spacing on Heat Transfer Burnout. Two burnout tests were conducted in the star test section with the surrounding-rod mockup unheated. The burnout heat fluxes were 25% above the burnout heat fluxes measured in 19-rod wire wrapped bundles at Columbia University and over twice the burnout heat fluxes measured at Hanford in a 19-rod wire wrapped bundle. The test results are in agreement with the results obtained on a 9-rod bundle at GE-APED in which the rod spacing was maintained by pins as in the star test section. The central heater was destroyed and the surrounding-rod mockup was damaged by an electrical arc that occurred at the end of the second burnout test. Repair of the test section is in progress. Sieve Tray Test. Tests to determine gas and liquid handling capacity of sieve trays with segmental downcomers were completed in February. Blower capacity was limited by operation at lower than design pressure but liquid handling capacity was exceeded at normal L/G ratios. In general, flow was limited to a maximum F-factor of 1.55 to 1.60 for stable operation by a flooding condition on the feed tray, similar in all respects to liquid carryover which has frequently limited operation of SRP first stage cold towers during this season of the year. The results thus far do not clearly define the cause of flooding. Tests in March, after installation of downpipes in the downcomer compartment, may clarify the effect of downcomer design. Hydride Orientation and Mechanical Properties of Thin-Walled Zircaloy Tubing. Additional tests of longitudinal specimens at stresses near 32,000 psi produced some reorientation of the hydrides; thus the stress orientation susceptibility in the longitudinal direction must be classified as low but not zero. Preliminary work on hydride location within the Zircaloy matrix showed that in drawn tubing less than $\frac{1}{4}$ of the hydride platelets were in the grain boundaries. (auth)

17999 (EURAEC-923) AN ADVANCED RESEARCH PROGRAM ON THE APPLICATION OF STEAM-WATER SPRAY TO THE COOLING OF LIGHT WATER REACTORS. CAN-2 Quarterly Progress Report No. 10, October 1–December 31, 1963. (Centro Informazioni Studi Esperienze, Milan). Dec. 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 060-61-7-RDI. 15p. (CISE-R-97)

Heat transfer experiments with annular geometry have been carried out. The test section was designed on the basis of experience gained during tests with annulus and clusters. A direct comparison between critical heat transfer experiments with and without spacers together with the knowledge of the position where the crisis first occurs, have given a qualitative understanding of the spacer effect. A deep analysis of all heat transfer data below and above the crisis also in transient conditions and of pressure drop data with and without power have been concluded. A hydrodynamic loop was operated for the completion of measurements of liquid hold-up in the test section through liquid level variation in the separator. Systematic experiments with this method were carried out with argon-water mixtures at various pressures. A seven-rod cluster was assembled and systematic experiments were started using argon-water mixtures at about 22 kg/cm^2 abs. Film thickness on the outer wall and on four internal rods and pressure drops were measured. The influence of mixing conditions on these quantities was also analyzed. An annular test element was designed to investigate the shadow effect produced by spacers. Dynamic corrosion tests on Zircaloy-2 in presence of steam-water mixture at different mass velocities were pursued. Corrosion tests with the same steam-water mixture in presence of 2 or 4 ppm of hydrogen were carried on. Some tests have been performed in order to analyze the influence of pressure inside the tubes on corrosion of Zircaloy-2 samples. Corrosion tests on heated samples have been carried out in "slow burn-out" conditions. (auth)

18000 (NP-13751(Vol.I)) ALKALI METALS BOILING AND CONDENSING INVESTIGATIONS. VOLUME I. Quarterly Progress Report 5, July 1, 1963–September 30, 1963. J. Longo, Jr., ed. (General Electric Co. Spacecraft Co. Spacecraft Dept., Cincinnati). Jan. 6, 1964. Contract NAS 3-2528. 120p.

The program reviewed is conducted to obtain two-phase heat transfer data for sodium and potassium under conditions of boiling and condensing. In addition, information related to pressure drop and flow stability are to be obtained. Test section development and materials studies related to the experimental work are conducted as a support effort. 300 kw facility testing was initiated with a helical swirl generator inside the boiler tube. Single-phase liquid data show significant improvement in heat transfer performance. Data taken on the same tube without the insert were reduced.

Operation with potassium as the heat transfer fluid continued without a major shutdown of the 100 kw facility. The operating characteristics of the 100 kw facility are reported. In the 50 kw facility, a significant improvement in the instrumentation and, therefore, the quality of the condensing heat transfer data was made. Extraneous emf's due to inhomogeneities in the thermocouple wire as well as at the junction between the lead wire to the cats block and the thermocouple wire from the test section were determined. Reinstrumentation of the test section to eliminate this error was accomplished. The operating characteristics of the 50 kw facility are reported. Problems encountered in instrumentation and checkout of the facility have delayed boiling operations. A significant change in data acquisition was made possible by the permanent installation of a digital recording system for all heat transfer facilities. A discussion of the recording system is presented. The results of tests leading to improved ductility of thermocouple wire for the 100 kw facility has shown W/3% Re to have more ductility than the pure tungsten. Thermocouples made with W/3% Re–W/26% Re should have more life than W–W:26% Re. Analyses of the considerations involved in using the boiler shell thermocouples in the 300 kw facility to infer local heat transfer performance are presented. Material support activities involving repair work on the 300 kw facility are discussed. (auth)

18001 (NP-13751(Vol.II)) ALKALI METALS BOILING AND CONDENSING INVESTIGATIONS. VOLUME II. Quarterly Progress Report 5, July 1, 1963–September 30, 1963. J. Longo, Jr., ed. (General Electric Co. Spacecraft Dept., Cincinnati). Jan. 6, 1964. Contract NAS-3-2528. 209p.

The boiling potassium heat transfer data obtained in the 300 kw facility with the nominal one inch molybdenum boiler tube are reported. (N.W.R.)

18002 (TID-20407) SINGLE- AND TWO-PHASE HEAT TRANSFER TO NEAR CRITICAL WATER UNDER FORCED CONVECTION IN AN ELECTRICALLY HEATED VERTICAL TUBE (thesis). Technical Report No. 14. Richard B. Wallace and P. W. McFadden (Purdue Research Foundation, Lafayette, Ind.). Jan. 1964. Contract AT(11-1)-1177. 208p.

Submitted by Richard B. Wallace to Purdue Univ., Lafayette, Ind.

Results of an experimental investigation of heat transfer to water in turbulent flow at high pressures are presented. The experimental apparatus was a closed circuit, forced convection water loop. The test section was a vertical, electrically heated stainless steel tube approximately four feet in length, ½ inch in diameter with a nominal wall thickness of 1/16 inch. In the investigation, carried out at pressures between 2560 and 3200 psia, the mass flux was varied between 1.5×10^6 and 2.9×10^6 lb/hr ft^2, the applied heat flux was varied between 113,700 and 398,100 B/hr ft^2, bulk water temperatures ranged from 606°F to saturation temperatures, and the Reynolds number in the test section varied between 207,000 and 475,000. Local property values, heat transfer parameters and selected dimensionless ratios were computed for each of thirteen positions along the length of the test section. Heat transfer coefficients, based on bulk fluid temperature, were found to range from 6500 to 53,000 B/hr ft^2 F, and reached a peak of 107,000 B/hr ft^2 F at the transition point in a two phase film boiling run. It was found that all single phase subcooled heat transfer data could be successfully correlated, in turn, by the well known Dittus-Boelter, Sieder-Tate, Colburn and Prandtl equations. An empirical correlation equation, developed from the Prandtl equation, successfully correlated the experimental subcooled single phase, subcooled boiling, and low quality nucleate boiling data. (P.C.H.)

18003 (TID-20408) BASIC EXPERIMENTAL STUDIES OF BOILING FLUID FLOW AND HEAT TRANSFER AT ELEVATED PRESSURES. BiMonthly Progress Report, January–February 1964. B. Matzner (Columbia Univ., New York. Engineering Research Labs.). Feb. 28, 1964. Contract AT(30-3)-187. 8p. (BPR-XIII-1&2-64)

Nineteen instrumented burnout points are reported for the 3-tube test section which consisted of three identical heated channels (0.495 in. ID and 87.9 in. heated length) connected to common inlet and outlet headers operating with vertical upflow at 1500 psia. The ranges of variables covered were: mass velocities from 1.1 to 4.2×10^6 lb/hr-ft^2, exit qualities from −2.3 to 32.6% and heat fluxes as high as 1.2×10^6 Btu/hr-ft^2. These burnout data are slightly lower (0–10%) than results for a single tube of similar dimensions. No evidence of hydraulic instability was found even when the test section was operated with a large unheated bypass flow. (auth)

18004 (UVA-321-64U) ONSAGER MINIMUM PRINCIPLE FOR STATIONARY FLOW IN AXIALLY SYMMETRIC ROTATING SYSTEMS. John L. Ging (Virginia. Univ., Charlottesville. Research Labs. for Engineering Sciences). Mar. 1964. Contract AT(40-1)-1779. 9p. (EP-3912-321-64U)

Onsager's principle of minimum entropy production for stationary gas flow in axially symmetric rotating system, states that a certain integral attains its minimum only if the flow is stationary and satisfies the linearized Navier-Stokes equations, the heat conduction equation, and the continuity equation. The principle is stated and proved, and an alternative form of the principle is also presented. (D.L.C.)

18005 (UVA-324-64U) EIGENVALUE PROBLEM—LIMIT OF LOW ANGULAR SPEED. John L. Ging (Virginia. Univ., Charlottesville. Research Labs. for Engineering Sciences). Mar. 1964. Contract AT(40-1)-1779. (EP-3912-324-64U)

The eigenvalue flow problem for the limiting case of a slowly rotating system is treated. The distribution of the eigenvalue spectrum is obtained. (D.C.W.)

18006 (UVA-325-64U) MODIFIED MINIMUM PRINCIPLE FOR STATIONARY FLOW IN A GAS CENTRIFUGE. John L. Ging (Virginia. Univ., Charlottesville. Research Labs. for Engineering Sciences). Mar. 1964. Contract AT(40-1)-1779. 8p. (EP-3912-325-64U)

The Onsager Minimum Principle applies to stationary gas flow in a rotating system. The dissipative effects are discussed, particularly the Eckman layers. The removal of these layers from the equations is accomplished by replacing them with surface integrals. The resulting modified principle is given. (D.L.C.)

18007 (UVA-326-64U) ONSAGER MINIMUM PRINCIPLE FOR AXIALLY DECAYING EIGENMODES. John L. Ging (Virginia. Univ., Charlottesville. Research Labs. for Engineering Sciences). Mar. 1964. Contract AT(40-1)-1779. 9p. (EP-3912-326-64U)

The Onsager minimum principle, which yields the small eigenvalues (long decay length modes) for stationary gas flows in rotating systems, is proved. (D.C.W.)

18008 (EURAEC-912) INVESTIGATION ON THE CRITICAL BURNOUT WITH BOILING WATER. Quarterly Report No. 9, October 1–December 31, 1963. H. H. Agena (Maschinenfabrik Augsburg-Nurnberg A. G., Nuremberg). Jan. 1964. Work Performed under United States–Euratom

Joint Research and Development Program. Contract 057-61-RDD. 10p. (A translation).

Tests were undertaken in connection with the energy balance of the test equipment. These gave rise to short-circuits in the insulated current leads, which caused considerable delay for transformation work. After the circuit was pressed into service again, some tests were made for checking the burnout detector. Due to a failure of the quick break switch in the HT circuit, the power was not switched off in time when a burnout occurred, so that the test tube blew out. The study of a calculation process for the void fraction of a two-phase flow was continued. The programmation work for the study of test results was continued. (auth)

18009 THE DIMENSIONAL DISTRIBUTION OF VAPOR BUBBLES IN A BOILING LIQUID. V. K. Zavoiskii. At. Energ. (USSR), 16: 64-5(Jan. 1964). (In Russian)

A formula was previously developed for determining the dimensional distribution of vapor bubbles in a bulk-heated liquid, (Atomnaya Energ., 10: 521(1961)), by measuring the dimensions of bubbles in pictures of rapidly boiling water heated electrically in a rectangular glass container. On the basis of the measurements, the radius of the equivalent sphere was calculated. Tests at lower levels of heating showed that the dimensional distribution remains unchanged. The data were used to determine the validity of the formula. It was found that the time of sojourn of the bubbles within the liquid is independent of their age, i.e., their dimension. The tests were carried out at atmospheric pressure and thus included all the vapor concentration ranges, which must be taken into consideration in the design of reactors moderated with boiling water. (TTT)

18010 ANALYSIS OF STEADY-STATE DENSITY CHANGES IN BOILING COOLANTS. V. E. Schrock (Univ. of California, Berkeley and CISE, Milan), J. B. van Erp, and G. Possa. Energia Nucl. (Milan), 11: 57-74(Feb. 1964).

An analytical method is presented for the calculation of changes in average density of boiling coolants in channel flow due to variations in the operating conditions. Of principle concern is the variation of the density with a change in reactor power level. This approximate analysis considers the coupled effects of flow rate, pressure level, and inlet enthalpy changes. It was developed for use in the rapid evaluation of the contribution of density changes to the overall static power coefficient of reactivity. It is particularly useful in the assessment of the mutual influence of such system components as pumps, preheaters, orifices, valves, turbines, etc., on coolant density changes in the heated channel. Time dependent effects are not included. (auth)

Materials Testing

18011 (DP-870) NONDESTRUCTIVE TEST OF CARBON BEDS FOR REACTOR CONTAINMENT APPLICATIONS. Progress Report, June 1962–December 1963. Albert H. Peters and David R. Muhlbaier (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Feb. 1964. Contract AT(07-2)-1. 19p.

A nondestructive technique was developed for evaluating carbon beds used in reactor containment applications. Freon-12 was used as a tracer to detect leak paths that would reduce the efficiency of carbon beds for removal of radioactive I_2 vapor. Leaks greater than 0.006% of the total flow were detected with an electron-capture-type instrument. The current method is suitable for testing dry carbon beds prior to field installation and at air velocities up to 20 ft/min. (auth)

18012 (HW-77465) A METHOD FOR MASKING ULTRASONIC TRANSDUCERS. N. E. Dixon (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 5, 1964. Contract AT(45-1)-1350. 18p.

Elliptical or line beam shapes can be obtained by masking. The ratio of beam dimensions normal to the direction of propagation can be controlled through limits by controlling mask dimension ratios with the maximum practical beam dimension ratio being approximately 10:17 for the lesser versus greater dimension. If operating frequency and water working distance are arbitrarily chosen, approximation of mask dimensions can be calculated. Absolute dimensions were unpredictable; however, beam dimensions decreased proportional to decreasing mask dimensions. Water working distance also decreased proportional to decreased mask dimensions. The recommended minimum mask dimension as a function of wavelength of ultrasound in the transmitter material is five to eight wavelengths. The masked beam shape consists of an eliptical one-lobe, far field, diverging angle of propagation pattern at the correct water working distance. Near field beam patterns used for inspecting thin wall tubing gave highly confusing signal relationships. Significant improvements in signal relationships for thin wall tubing tests were noted with the eliptical beam when compared to the flat circular driver beam with both being used at the water working distance corresponding to the last peak in the near field. (auth)

18013 (HW-78701) ULTRASONIC WAVE PROPAGATION MODELS FOR NONDESTRUCTIVE TESTING: LIQUID-LIQUID INTERFACES. C. E. Fitch (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 1963. Contract AT(45-1)-1350. 50p.

Basic analytical and experimental studies to determine the accuracy of simple plane wave ultrasonic propagation models in liquids were made. Liquid-liquid interfaces were chosen for initial studies on the effects of attenuation and boundary waves. Plane waves, infinite in both time and space, incident on a liquid-liquid interface were studied analytically for the cases where neither liquid was attenuating, where only the refracting liquid was attenuating and where both liquids were attenuating. Comparison of the reflection and transmission coefficients and the attendant phase shifts for the three conditions showed only minor differences when a kerosene-glycerine interface was considered. The presence of attenuation, however, changed the form of the waves that propagate in both liquids. Without attenuation inhomogeneous boundary waves were generated at incident angles equal to and exceeding the critical angles. With attenuation the refracted waves were always inhomogeneous. Attenuation also resulted in a complex wave leading to a modified form of Snell's law, which did not exhibit a critical angle. (P.C.H.)

18014 (HW-79928) CRITICAL ANGLE ULTRASONIC TESTS. C. E. Fitch, Jr. and B. W. Chettle (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 31, 1963. Contract AT(45-1)-1350. 23p.

It has been shown that boundary waves are generated by ultrasound incident at the critical angles on interfaces between acoustically dissimilar media. The presence of these waves, which travel along the interface and have shallow penetration, causes some unusual perturbations in the reflected waves. A reflected beam, for example, suffers a lateral shift along the interface and a redistribution of energy across the beam. These effects have been

demonstrated and used to measure Zircaloy-2 surface hydride in amounts as small as 300 ppm. Compressive surface strains of about μin./in. in brass and 300 to 500 μin./in. in aluminum were also detected. A maximum strain of about 500 μin./in. in stainless steel did not produce a measurable effect. Boundary wave generation was shown to exist also for solid-solid interfaces. A frequency of 5 Mc was used throughout the experiments; at this frequency the waves penetrated to a depth about half way between the shear and longitudinal wavelengths. These experiments, though preliminary, have shown that critical angle tests with boundary waves may provide a new use for ultrasound in nondestructive testing. (auth)

18015 (SB-411(Suppl.1)) MATERIALS TESTING. (INCLUDES NON-DESTRUCTIVE TESTING). (Office of Technical Services, Washington, D. C.). Nov. 1963. 23p.

Approximately 400 references are presented to reports published in U.S. Government Research Reports and Technical Translations. (D.L.C.)

18016 RADIOISOTOPE SOURCES FOR RADIOGRAPHY. R. S. Pressly. Isotopes Radiation Technol., 1: No. 2, 174-7 (Winter 1963-64).

The preparation of radiation sources for use in nondestructive testing is reviewed. Low-energy gamma-emitting isotopes and bremsstrahlung sources are considered. (M.C.G.)

18017 FAILURE TESTS ON CYLINDRICAL STEEL VESSELS CONTAINING AXIAL FAULTS. E. Bevitt, A. Cowan, and A. L. Stott (United Kingdom Atomic Energy Authority, Warrington, Lancs, Eng.). J. Brit. Nucl. Energy Soc., 3: 16-30(Jan. 1964). (TRG-Report-686)

Hydraulic and pneumatic pressure tests were made on 5 ft dia 1 in. wall thickness cylindrical steel vessels containing longitudinal through-thickness sealed defects from 3–24 in. in length. The nominal circumferential stress for crack initiation decreased with defect length and was below the yield stress for defects as short as 6 in. The failure stress increased with temperature and did not show any transition at the crack arrest temperature or the NDT values of the steel. The failure stress was independent of pressurizing conditions but the extent of damage resulting from crack propagation was influenced by failure pressure, compressibility of the pressurizing medium and temperature. The tests also gave some evidence of the effect of residual stress and the stabilizing effect of pressurizing at higher temperatures. (auth)

18018 SOME FUNDAMENTAL ASPECTS ON THE PRESSURE STRENGTH OF STEEL PRESSURE VESSELS. D. K. Common (Central Electricity Generating Board, London). J. Brit. Nucl. Energy Soc., 3: 53-8(Jan. 1964).

Some of the fundamental aspects that affect the overall pressure strength of steel pressure vessels are discussed. Basic stress levels, design and construction method, and relation between defect size and pressure strength are considered. Two generalizations are made: if a vessel successfully withstands a pressure test to a value Pt at a temperature Tt, the vessel may subsequently be operated under similar conditions of external loading at pressures up to Pt and at any temperature within wide limits below Tt without loss of pressure strength; and the pressure strength of a vessel on its first pressure test is dependent on the test temperature Tt. (P.C.H.)

18019 "4000 TON TEST RIG" A TESTING APPARATUS FOR BRITTLE FRACTURES IN THICK STEEL PLATES FOR REACTORS. Nobukazu Ogura. Shipping (Tokyo), 36: 884-9 (Aug. 1963). (In Japanese)

The "4000-ton Test Rig" was constructed to test welded joints in thick steel plates. Information obtained from tests with the rig is used to correlate nondestructive test data with the static strength of welded joints, determine safety factors for brittle fracture of thick steel plates and welded joints, and correlate results with those of small-scale rigs. The "4000-ton Test Rig" and other test rigs in the world are described. (from NSA of Japan)

Vacuum Engineering

18020 (SC-TM-64-536) A CONTROLLED-ENVIRONMENT FILM DEPOSITION SYSTEM. Preliminary Report. W. E. Bergsten, N. L. Knudsen, and J. F. McDowell (Sandia Lab., Albuquerque, N. Mex.). Apr. 1964. Contract AT(29-1)-789. 8p.

A description is given of a vacuum deposition station that provides clean air access to the vacuum bell and has automatic cycle sequencing. The system is equipped for thermal evaporation, sputtering, ion plating, and electron-beam processing. (auth)

18021 (TID-20411) SORPTION OF GASES ON METAL SURFACES IN ULTRA-HIGH VACUUM. Quarterly Progress Report No. 6, August 15–November 15, 1963. R. A. Pasternak (Stanford Research Inst., Menlo Park, Calif.). Dec. 4, 1963. Contract AT(04-3)-425. 16p.

Sorption of xenon on clean molybdenum films and on the glass support was investigated. A theoretical consideration of the physisorption of gases by surfaces was initiated. Pumping of deuterium by ion gages was explored as a preliminary step in the study of deuterium sorption by molybdenum films. The rate of deuterium–hydrogen exchange on the coated filament in the mass spectrometer was examined briefly. An electronic control unit for a magnetic deflection type mass spectrometer was built. (M.C.G.)

18022 HYDROGEN PRESSURE REGULATOR WITH HIGH ABSORPTION RATE. O. Reifenschweiler (Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). Rev. Sci. Instr., 35: 456-60(Apr. 1964).

By evaporating titanium in an argon atmosphere a deposit consisting of a very fine powder (particle size about 100 Å) is obtained on the inner wall of a metal cylinder. After this powdered titanium has been made to absorb whatever hydrogen isotope is being used, the gas pressure is adjusted by heating the metal cylinder to a certain temperature. Compared with more familiar systems, this pressure regulator has the advantage that equilibrium pressure establishes itself very quickly. One application of the regulator is in sealed-off neutron tubes. (auth)

18023 ULTRAHIGH VACUUM SYSTEM FOR USE WITH A POLARIZING SPECTROMETER. J. F. Dettorre, T. G. Knorr, N. F. Hartman, and G. G. Cocks (Battelle Memorial Inst., Columbus, Ohio). Rev. Sci. Instr., 35: 503-6(Apr. 1964).

An ultrahigh vacuum system which can be used in conjunction with a commercial polarizing spectrometer is described. The capabilities of the combined systems are such that surfaces can be prepared and observed in situ on substrates held at temperatures anywhere between liquid nitrogen and about 800°C. In addition, it is possible to introduce a variety of gases by means of a controlled leak, permitting the study of many different interfacial phenomena and the kinetics of the reactions involved. Preliminary data on evaporated copper is shown which is essentially different than previously reported results

even though the data shown were taken from samples purposely held at only modestly improved pressures.(auth)

18024 LEYBOLD VAKUUM-TASCHENBUCK. (Leybold Vacuum-Pocketbook). K. Diels and R. Jaeckel. Berlin, Springer-Verlag, 1962. 376p. DM 56.

Vacuum physics and technology are discussed. Gas kinetics, flow processes, guides for selecting vacuum pumps, impurity removal, vacuum instrumentation, partial-pressure measuring devices, leakage and leakage detection, and ultrahigh vacuum techniques are discussed. Vacuum accessories and materials and their properties are described. Gas pressure idle time and gas delivery and gettering are discussed. Approximately 4000 references are presented. (R.E.U.)

GEOLOGY AND MINERALOGY

General

18025 (NP-13775) SEISMIC WAVES FROM AN UNDERGROUND NUCLEAR EXPLOSION UNDER A DESERT VALLEY. D. S. Carder, D. W. Gordon, and J. N. Jordan (Coast and Geodetic Survey, Washington, D. C.). June 1963. 59p.

Results are reported of a comprehensive study of basic seismic data from the MISSISSIPPI event at the Nevada Test Site. The event was accompanied by several collapses, and the seismic data are from stations in and outside U.S. Magnitudes, travel times, amplitudes, and other parameters are tabulated and plotted. Results of epicenter computations are given, and the nature of the collapses is discussed. (D.L.C.)

18026 (NP-13786) URANIUM IN AUSTRALIA. A Collection of Articles on the History and Development of the Uranium Mining Industry in Australia. (Australia. Atomic Energy Commission). 1962. 64p.

Eight articles are presented on the establishment of a uranium mining industry in Australia. The articles discuss the development of the uranium industry from 1944 to 1961, aerial prospecting, Radium Hill, Rum Jungle, Mary Kathleen, radiometric sorting of uranium ore, and uranium exploration in South Alligator Area, N. T. (D.L.C.)

18027 THE ISOTOPIC COMPOSITION OF MAGNESIUM IN TERRESTRIAL SAMPLES. Makoto Shima (Univ. of California, La Jolla). Bull. Chem. Soc. Japan, 37: 284-5 (Feb. 1964).

Studies were made on the variation in the isotopic abundance of the stable isotopes of Mg in terrestrial samples. Results of analyses on standard rocks, sea water, and chemical reagents showed that within the limits of the samples and of analytical error, no difference in the isotopic ratio among the terrestrial magnesium samples was established. (P.C.H.)

18028 ISOTOPIC COMPOSITION OF BORON IN NATURE. Yu. P. Shergina and A. B. Kaminskaya. Geochemistry (USSR) (English Transl.), No. 8, 756-63(1963).

A method of extraction of boron from rocks was developed that permits isotopic analysis of boron by thermionic emission of borax ($Na_2B^{10}O_2^+$ and $Na_2B^{11}O_2^+$) in rocks that contain as little as $5 \cdot 10^{-4}$% B. The reproducibility of the analysis is 0.2%. The method of chemical separation was demonstrated to cause only negligible isotopic separation (1.001). Studies of a high temperature silver-antimony deposit and a copper-nickel sulfide deposit show that fractionation of up to 2.5% occurs in boron isotopes in nature. The fractionation may be partly thermal in origin, but isotopic exchange between feldspar and phyllite in the country rock and the hydrothermal ore solutions must also have occurred. (auth)

18029 LEAD ISOTOPE COMPOSITION IN VOLCANIC ROCKS OF JAPAN. Akimasa Masuda (Tokyo Univ.). Geochim. Cosmochim. Acta, 28: 291-303(Mar. 1964).

Three series of volcanic rocks (pigeonitic, hypersthenic, and alkali rocks) were investigated as to their isotopic compositions of lead. Each series falls close to a characteristic line with negative trend in the $^{206}Pb/^{208}Pb$ vs $^{207}Pb/^{208}Pb$ diagram. As fractional crystallization does not cause changes in the isotopic composition of lead, this characteristic trend line can be interpreted as indicating the difference in the original sources of these three series. Meanwhile, the difference within the same series suggests that magmatic differentiation did not always proceed under the closed condition with respect to lead and the addition of lead more or less enriched in recent radiogenic lead took place. On the other hand, it is shown that the increase of content of lead is accompanied very commonly by the increase in the abundance ratio $^{206}Pb/^{207}Pb$. This seems to suggest that the addition of exogenous (probably crustal) lead took place during the passage of magma to the surface even in the series believed to be free from contamination regarding the major chemical components. According to the interpretation in terms both of zone melting and of systematic variation of radiogenic lead in the crust and mantle, the depth of the original source is inferred to be in the order of alkali olivine basalt > high-alumina basalt (?) > tholeiite. The method used consisted of separation of lead by heating with carbon, purification by electrodeposition, and preparation of tetramethyl lead followed by mass spectrometry. (auth)

18030 DATING OF URANIUM MINERALS BY THE SPECIFIC RADIOACTIVITY OF LEAD. A. W. Fairhall (Univ. of Washington, Seattle). J. Chem. Educ., 40: 626-33(Dec. 1963).

A method for estimating the age of a U mineral without recourse to elaborate mass-spectrometric techniques is described. The method is a very crude one; however, its purpose is to serve as the basis for simple radiochemical manipulations, which are instructive as an illustration of the principle of age determination of a mineral via radioactivity. The outlined experiments are suitable for use at the undergraduate or senior high school level, and only very rudimentary equipment is required, consisting of a Geiger counter, a set of Al absorbers, and few elementary pieces of chemical apparatus. The raw material is pitchblende ore, and reagent grade uranyl nitrate is the only other special chemical which is needed. In addition to the experiments outlined, the following demonstrations are also possible with these radioactive samples: studies of backscattering of β radiation by various thicknesses and various kind of material, the determination of a decay curve, determination of the complete absorption curve of a sample for an estimation of the range of a given β emitter, and separation of ^{210}Bi from ^{210}Pb by a variety of techniques. The pitchblende is a rich source of other radioelements which the student can isolate, for example, Ra and Po, and it can serve as the starting point for other radiochemical experiments. The dating method applied to U minerals involves the isolation of radiogenic and measurement of its β activity. The observable specific activity of chemically isolated lead, due only to ^{210}Bi, is referred to a graph which represents a function of the U mineral formation time for various times after the isolation of lead. By the use of this graph the age of a U mineral may be determined by observation of the radioactivity associated with lead isolated from the mineral. Experiments illustrating the measurement of the counting efficiency of a sample are also described. (BBB)

18031 SHOCK EMPLACED ARGON IN A STONY METEORITE. 1. SHOCK EXPERIMENT AND PETROLOGY OF SAMPLE. Kurt Fredriksson (Univ. of California, San Diego) and Paul De Carli. J. Geophys. Res., 69: 1403-6 (Apr. 1, 1964).

A sample of the Bjurböle chondrite was exposed to artificial shock in an argon atmosphere. The sample consisted of grayish-white powdery material with chondrules. This shock changed the material to fine-grained black and well-indurated rock, similar to a black chondrite. Subsequent analysis (see part 2 of this paper) showed that the shocked sample had incorporated considerable amounts of argon, most of which was retained even at high temperatures and was not released until the material was melted. These results support earlier suggestions that the irregular distribution of rare gases, as well as the light-dark structures in such meteorites as Pantar and Kapoeta, could have been caused by shock waves. (auth)

18032 SHOCK EMPLACED ARGON IN A STONY METEORITE. 2. A COMPARISON WITH NATURAL ARGON IN ITS DIFFUSION. R. O. Pepin, J. H. Reynolds, and G. Turner (Univ. of California, Berkeley). J. Geophys. Res., 69: 1406-11(Apr. 1, 1964).

Analysis was made of the argon incorporated in stony meteorites by shock waves. The shocked sample was heated for one hour at 600, 1000, and 1600°C, and the argon evolved was collected on activated charcoal. Results are given for shocked and unshocked samples. (R.E.U.)

18033 ISOTOPIC COMPOSITION OF THE RARE GASES IN THE FAYETTEVILLE METEORITE. O. K. Manuel and P. K. Kuroda (Univ. of Arkansas, Fayetteville). J. Geophys. Res., 69: 1413-19(Apr. 1, 1964). (TID-19474)

The abundance pattern of the rare gases in the dark phase of the Fayetteville meteorite was found to be similar to that of the Pesyanoe and other meteorites rich in primordial rare gases. The light phase of the Fayetteville meteorite contains much smaller amounts of rare gases and is characterized by the presence of radiogenic ^{40}Ar and cosmogenic ^{21}Ne, ^{22}Ne, etc. Both dark and light phases contain an excess of radiogenic ^{129}Xe relative to the earth's atmosphere; the light phase contains an excess of fissiogenic xenon isotopes relative to the dark phase of the meteorite. (auth)

18034 SHORT PAPERS IN GEOLOGY AND HYDROLOGY. ARTICLES 122-172. (Geological Survey, Washington, D. C.). Geological Survey Professional Paper 475-D. 228p. (GPO)

Fifty-one papers are included; separate abstracts were prepared for 4. The remaining articles on stratigraphy and structural geology, mineralogy and petrology, geochemistry, geochronology, geophysics, economic geology, sedimentation, paleontology, glacial geology, analytical techniques, geochemistry of water, analytical hydrology, marine hydrology, surface water, ground water, and hydrologic instrumentation were not in scope for NSA. (P.C.H.)

For abstracts of individual papers see: 18035, 18036, 18037, and 18060.

18035 DETERMINATION OF THE ION-EXCHANGE CAPACITY OF A ZEOLITIC TUFF. Harry C. Starkey (Geological Survey, Denver). p.D93-5 of "Short Papers in Geology and Hydrology. Articles 122-172." Washington, D. C., Geological Survey, 1964.

Determination of the exchange capacity of some zeolitic tuffs may require an extremely long time for the reaction rate to attain a constant value. A heating method is suggested whereby the rate of the reaction is increased, so that the exchange-capacity determinations can be made within a period of time as short as 24 hours. (auth)

18036 CRUSTAL STRUCTURE IN THE VICINITY OF LAS VEGAS, NEVADA, FROM SEISMIC AND GRAVITY OBSERVATIONS. John C. Roller (Geological Survey, Denver). p.D108-11 of "Short Papers in Geology and Hydrology. Articles 122-172." Washington, D. C., Geological Survey, 1964.

According to a seismic-refraction profile the thickness of the crust north of the Las Vegas Valley shear zone is 32 km, but it thins to 27 km, south of that structure, within the short distance of 25 km. This decrease correlates with an increase in the Bouguer anomaly and a decrease in the average surface altitude. The data imply that: major fracture zones may extend to the Mohorovicic discontinuity and probably penetrate the mantle; and the Mohorovicic discontinuity is not flat, but instead includes major flexures over relatively short horizontal distances. (auth)

18037 RELATION OF PERCENT SODIUM TO SOURCE AND MOVEMENT OF GROUND WATER, NATIONAL REACTOR TESTING STATION, IDAHO. F. H. Olmsted (Geological Survey, Yuma, Ariz.). p.D186-8 of "Short Papers in Geology and Hydrology. Articles 122-172." Washington, D. C., Geological Survey, 1964.

Most of the ground water in the National Reactor Testing Station is of the calcium magnesium bicarbonate type. The percent sodium decreases northwestward, where the source of recharge is a limestone and dolomite terrane, and increases southeastward, where the source is in silicic volcanic rocks and lacustrine deposits. (auth)

Natural Radioactivity and Fallout

Refer also to abstracts 17429, 17432, 18062, 18069, 18070, 18075, 18092, and 18110.

18038 (AECL-1874) RADIOACTIVITY IN WINNIPEG RIVER WATER, OCTOBER 1961–SEPTEMBER 1963. Preliminary Results from the WNRE Pre-Operational Environmental Survey. J. E. Guthrie (Atomic Energy of Canada Ltd. Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). Jan. 1964. 18p.

Preliminary results of the Whiteshell Nuclear Research Establishment Pre-Operational Environmental Survey are presented. Strontium-89, ^{90}Sr, ^{137}Cs and total β activities in Winnipeg River water sampled during the period October 1961 to September 1963, and the results of the γ-spectrometric analyses are given. These measurements show the effect of the resumption of nuclear weapons testing on the radiostrontium and radiocesium content of the river water. During the period reported, the mean concentrations of ^{90}Sr and ^{137}Cs were 1.9 pC/l and 0.24 pC/l respectively. A complete report, giving the results of land and river-bed γ surveys and the analyses of vegetation, fish, soil, river-bed sediment, precipitation (fallout) and river water will be published later. (auth)

18039 (AECL-1889) THE DISPERSION OF TRITIUM IN PERCH LAKE. J. W. McMahon (Atomic Energy of Canada Ltd., Chalk River, Ont.). Jan. 1964. 17p.

A water survey showed that tritiated water from the Liquid Disposal Area on C.R.N.L. property is evenly dispersed throughout a small natural reservoir, Perch Lake. The average tritium concentration in the lake (1.14 μC/l), over an 8-month period, represented only 3.8% of the occupational 168-hr $(MPC)_w$. Complete mixing of water occurs in the lake under both winter and summer conditions. The presence of a subterranean spring in Perch Lake and variations in tritium concentration in Perch Lake Swamp and marginal areas of the lake are discussed. (auth)

18040 (BIO/03/63) DATA ON ENVIRONMENTAL RADIOACTIVITY COLLECTED IN ITALY (JULY–DECEMBER 1962). (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). May 1963. 478p.

Results are reported from measurements of environmental radioactivity due to fallout in samples collected throughout Italy from July through December 1962. Data are included on total β activity or content of selected fission products in samples of surface water, drinking water, sea water, air, plants, milk, bones, fish, snails, and soil. The fission products included ^{89}Sr, ^{90}Sr, ^{137}Cs, ^{95}Zr, ^{95}Nb, ^{141}Ce, ^{144}Ce, ^{103}Ru, and ^{106}Ru. (C.H.)

18041 (HASL-144) FALLOUT PROGRAM QUARTERLY SUMMARY REPORT, DECEMBER 1, 1963–MARCH 1, 1964. Edward P. Hardy, Jr., Joseph Rivera, and William R. Collins, Jr. (New York Operations Office. Health and Safety Lab., AEC). Apr. 1, 1964. 305p.

Current data are presented from the HASL Fallout Program, the U. S. Naval Research Laboratory, the New Zealand Department of Scientific and Industrial Research, the National Radiation Laboratory in New Zealand, and the Department of National Health and Welfare in Canada. Radionuclide levels in fallout, milk, tap water, and upper air samples are given in tabular form. Also included are interpretive reports and notes dealing with air volume measurements in the high altitude balloon sampling program, ^{144}Ce measurements in vegetation and soil, ^{90}Sr levels in infant and adult diets and the 1963 wheat crop, and the distribution of ^{90}Sr in two human skeletons. A bibliography of recent literature pertinent to fallout studies is included. (C.H.)

18042 (RT/PROT(63)-14) RACCOLTA E MISURA DELLO I^{131} IN ARIA. (Collection and Measurement of I^{131} in Air). A. A. Cigna and F. G. Giorcelli (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Oct. 1963. 11p.

A charcoal filter allowing separation of ^{131}I from air is described. A set of concentration values of ^{131}I in air during the period running from last days of October to the first days of December 1961 is reported. (auth)

18043 (JPRS-23912) NATURAL RADIOACTIVITY OF SOILS. V. I. Baranov and V. I. Vernadskii. Translated from Izv. Akad. Nauk SSSR, Ser. Biol., 29: No. 1, 159-63 (1964). 9p.

Various methods for measuring the natural radioactivity of the soil are discussed and evaluated as to the accuracy of results. Factors affecting natural soil radioactivity and problems connected with measuring soil radioactivity are discussed. (C.H.)

18044 A COMPARISON OF NATURAL AND FALLOUT RADIOACTIVITY IN ONTARIO SOILS UNDER PINE. Eville Gorham (Univ. of Minnesota, Minneapolis). Can. J. Botany, 41: 1309-18(Sept. 1963).

The radioactivity of organic litter layers of pinewood soils of southern Ontario sampled in the spring of 1962, after resumption of thermonuclear weapons testing, was about 12 times that of soil samples from the same region collected during the spring of 1961 and about 30 times the natural β activity before worldwide thermonuclear fallout. Mineral soils sampled during the same periods showed little differences in radioactivity. Leaf litter from angiosperm trees was more radioactive than litter from gymnosperm trees. (C.H.)

18045 INFLUENCE OF AGE OF RADIOACTIVE FALLOUT MATERIAL UPON ITS DEPOSITION IN MILK AND VERTICAL DISTRIBUTION IN SOIL. Anita A. Jarvis, J. R. Brown (Univ. of Toronto), and D. R. Arnott. J. Dairy Sci., 47: 68-73(Jan. 1964).

Milk samples from Jersey and Holstein cows analyzed for ^{90}Sr and Ca and Sr unit (SU) values during the spring and summer of 1961 showed that the SU values ($\mu\mu C$ ^{90}Sr/g Ca) were significantly higher in the spring (April–May 1961) than in the samples (July–August 1961). This difference may have been due to a higher Ca intake during pasture feeding in the summer or because during the spring months the cows were fed silage and hay grown in the summer of 1960, when the ^{90}Sr fallout in Ontario was relatively higher than in 1961. The difference in the fallout rate between the spring and summer periods probably explained the higher levels of ^{90}Sr in the spring milk samples. In a further investigation using the same cows, milk samples were obtained six weeks after the first announced resumption of an atmospheric nuclear detonation in October 1961, about two months after the collection of summer samples from July 17 to August 18. The data were examined to seek evidence whether ^{89}Sr, ^{90}Sr, and SU values of milk increased from the summer to the fall sampling periods, and whether an increase in the amount of atmospheric ^{89}Sr and ^{90}Sr was similarly reflected in the isotope content of the milk sample of the two breeds of cows. Milk samples showed consistently higher SU and ^{90}Sr values in October than in August 1961, and the presence of ^{89}Sr was evidence of fresh fallout, proving that the delay period for introduction of Sr in milk is less than two months. The soil samples taken from the site where the cows grazed showed no increase of ^{90}Sr and no evidence of ^{89}Sr. In grass, however, there was a sharp increase of both isotopes from September to November 1961, the simultaneous rise suggesting recent pollution. The effective delay period, therefore, for fallout to be incorporated into grass was less than two months. That there was no increase in either isotope in the soil suggests that the isotopes entered the vegetation by direct routes. The average SU values were higher in Holstein milk than in milk obtained from the Jersey cows tested. In the October samples the mean SU values were 2.358 for Holstein milk as compared with 1.987 for Jersey samples. This significant difference was most likely due to the consistently higher levels of Ca in Jersey milk in October 1961 (1.380 g/l for Jersey, and 1.150 g/l for Holstein milk). Data for soil and grass concentrations of the isotopes are tabulated. (BBB)

18046 DETERMINATION OF RADIOACTIVITY IN AUSTRIA. MEASUREMENT OF THE ENVIRONMENTAL RADIOACTIVITY OF FOOD IN 1961. G. Woller and P. Vychytil. Mitt. Oesterr. Sanitaetsverwalt., 64: No. 2, 42-55(1963).

In the first, second, and third trimester of 1961 radioactivity was extremely slight. During the nuclear tests in the autumn of 1961, up to the end of the year, the radioactivity of the air, drinking water, and food was a slight percentage of the maximum permissible value. In cistern water the concentration of total beta activity sometimes exceeded the maximum permissible value. Various radioactive isotopes were estimated individually: radioactivity of the biologically dangerous isotopes was below the maximum permissible value. Unlike Germany and Switzerland, Austria has many cisterns and so the drinking-water requirements can be met almost completely from underground water and springs. (Public Health Eng. Abstr., 44: No. 3 (Mar. 1964))

18047 STRONTIUM-90 AND CAESIUM-137 IN ARCTIC VEGETATION DURING 1961. Anneli Salo and Jorma K. Miettinen (Univ. of Helsinki). Nature, 201: 1177-9(Mar. 21, 1964).

^{90}Sr and ^{137}Cs analyses of plant samples collected from Finnish Lapland in the summer of 1961 are reported. Samples (weighing about 200 g each) were taken from separate places within the same ecological habitat, dried, and analyzed by γ spectroscopy. Means values in lichens were 5.5 ± 2 nC/kg for ^{90}Sr and 11 ± 4 nC/kg for ^{137}Cs. Forage plants other than lichens were also analyzed, as were the leaves of birch and willow. (H.M.G.)

18048 RADIOLOGICAL HEALTH DATA [MONTHLY REPORT], VOLUME V, NUMBER 3. (Public Health Service, Washington, D. C.). Mar. 1964. 46p. $0.50(GPO).

Data are summarized on fission product radioactivity due to fallout in samples of airborne particulates and precipitation collected throughout the U. S., Canada, Mexico, Pan America, and along the 80th meridian during October, 1963. Data are included on the content of ^{89}Sr, ^{90}Sr, and ^{137}Cs in milk samples collected throughout the U. S. during 1961, 1962, and 1963; the radioactivity in surface waters in 1963; the radioactivity of diets sampled during 1963; and environmental levels of radioactivity at the Shippingport Atomic Power Station from June 1962 to July 1963. One low-intermediate-yield underground nuclear detonation at the Nevada Test Site was reported during Feb. 1964. Separate abstracts were prepared for two sections of this report. (C.H.)

For abstracts of individual items see: 17454 and 17762.

18049 RESULTS OF THREE-YEAR SYSTEMATIC MEASUREMENTS OF NUCLEAR FALLOUT. Vilem Santholzer (Charles Univ., Hradec Kralove, Czechoslovakia). Sb. Ved. Praci Lekar. Fak. Karlovy Univ. Hradci Kralove, Suppl., 5: 205-14(1962). (In Czech.)

A survey is presented of results of the measurement of radioactivity in rainout from November 1, 1956 to April 15, 1960, and in fallout from November 1, 1958 to April 5, 1960. The results demonstrate the temporary cessation of nuclear tests by November 1, 1958. Cumulative activity in the course of the second half-year after the stopping of nuclear tests decreased to 45% of cumulative activity of the first half-year (from November 1, 1958 to April 30, 1959). By the end of 1959 a further decrease appeared. Rainout activity levels reached three maxima (of increasing height) over the period studied, centering about August 1957, April 1959, and March 1960. Closer analysis of the last maximum shows a very large increase of activity on March 1, 1960 (corresponding to the first Sahara test) and a lower maximum on April 9, following the 2nd test. The fallout maximum corresponding to the first Sahara test occurred on March 2, 1960 and reached ~18 mC/km^2/day on that date. By March 31, it had fallen to 0.01 mC/km^2/day. Regularities in the temporal decrease with time in the activity of fallout are shown. On the basis of long-term observations, it is shown that samples of fallout with large activity have relatively very small admixtures from the previous nuclear tests, so that in a period of several weeks or even months they can be considered as practically separate samples of fission products. The exponent n in the disintegration formula $A = at^{-n}$ is most frequently equal to 1.2 for the period of the first 3 to 4 months after detonation. For older samples of fallout, n is equal to 1.5 in most cases. Energy of β and γ rays from the fallout was estimated on the basis of absorption measurements. It was shown that the quality of β radiation varies with the age of the samples of fallout. (BBB)

18050 ENVIRONMENTAL RADIONUCLIDES IN MUNICIPAL WASTEWATER. S. K. Bhagat (Univ. of Texas, Austin) and E. F. Gloyna. Water Sewage Works, 110: 205-9(June 1963).

The fates of ^{90}Sr and ^{226}Ra in a domestic wastewater were investigated. These analyses were accomplished by tracing ^{90}Sr and ^{226}Ra concentrations in the wastewater treatment plant of Austin, Texas, plant influent, activated sludge, and plant effluent. The results indicate that the Austin wastewater treatment plant removed on the average about 38% of the ^{90}Sr, 38% of the gross beta radioactivity, and 18% of the ^{226}Ra from the liquid fraction. The average reduction of BOD and suspended solids in the treatment plant during this study was 62% and 78%, respectively. (Public Health Engr. Abstr., 44: No. 3 (Mar. 1964))

Techniques and Equipment

18051 TECHNIQUES OF ON-SITE INSPECTION. Warren H. Westphal, and Sylvan Rubin (Stanford Research Inst., Menlo Park, Calif.). Geophysics, 29: 250-8(Apr. 1964).

On-site inspection of an unidentified seismic event comprises observations and measurements in a defined geographic area to distinguish between underground nuclear explosions and other sources of signals. If the event is determined to be a nuclear explosion, the detonation point must be located with sufficient precision to permit collection of radiochemical samples. This target will be a relatively small cavity or rubble zone buried at a depth at least ten times its diameter. A well-executed test will be essentially devoid of surface evidences of emplacement activities and explosion. Suggested techniques of on-site inspection include visual observations, aerial imaging, seismic-noise monitoring, radiochemical and radioactivity exploration, electrical geophysics, and magnetic, geothermal, and gravity measurements. Some of these techniques are similar to those used by the exploration industry. Successful application to on-site inspection problems requires intensive research and important modifications. (auth)

18052 ISOTOPE TECHNIQUES FOR HYDROLOGY. Report of the Panel on Use of Isotopes in Hydrology Held in Vienna, December 17-21, 1962. (International Atomic Energy Agency, Vienna). Technical Report Series No. 23. 1964. 38p. STI/DOC/10/23. $1.00; Sch 21; 6 s. stg; F. fr 4; DM 3.20. (IAEA)

A discussion is presented of isotope techniques for the study of hydrological problems in the development of water resources. Among the topics discussed are ground-water dating, short-term ground-water tracing, field experiments, specific ground-water problems, surface-water applications, and health and safety aspects. (D.L.C.)

18053 DEEP WATER ISOTOPIC CURRENT ANALYZER. W. H. Johnston (to U. S. Atomic Energy Commission). U. S. Patent 3,120,304. Apr. 21, 1964.

A deepwater isotopic current analyzer, which employs radioactive isotopes for measurement of ocean currents at various levels beneath the sea, is described. The apparatus, which can determine the direction and velocity of liquid currents, comprises a shaft having a plurality of radiation detectors extending equidistant radially therefrom, means for releasing radioactive isotopes from the shaft, and means for determining the time required for the isotope to reach a particular detector. (AEC)

18054 PRODUCTIVITY WELL LOGGING BY ACTIVATION ANALYSIS AND FLUID WITHDRAWAL. Hugh E. Hall, Jr. (to Texaco Inc.). U. S. Patent 3,127,511. Mar. 31, 1964. Filed Jan. 25, 1960.

A method is given for locating the points of entry of water into a borehole in an oil well. The method comprises withdrawing fluid from the borehole at a known rate, activating the chlorine in the salt water entering from the formation, detecting the arrival of the activated water downstream, and timing the arrival to determine the velocity and amount of the activated water. This method is repeated, carrying out the activation step at different levels; thus, the points of entry of the water can be determined. A neutron source-detector apparatus for carrying out the method is described. (D.L.C.)

18055 NEUTRON-GAMMA GEOPHYSICAL PROSPECTING METHOD AND APPARATUS. Ralph Monagham (to Well Surveys, Inc.). U. S. Patent 3,127,512. Mar. 31, 1964. Filed June 30, 1958.

An apparatus for carrying out simultaneously neutron-gamma and activation logging operations in wells is designed which prevents problems due to activation of the scintillation counter by scattered slow neutrons. The counter is shielded from slow neutrons by a casing of a material containing either ^{10}B or ^{6}Li, preferably a mixture of boron-10 carbide and a hydrogenous resin. The heavy charged particles emitted by boron or lithium on neutron bombardment are easily removed by a thin shield. (D.L.C.)

Thorium and Uranium Minerals

18056 (CEA-2333) ETUDE DES ÂGES DES MINÉRALISATIONS URANIFÈRES DU GISEMENT DU LIMOUSIN, MASSIF DES BOIS-NOIRS. (Study of the Age of Uraniferous Minerals in the Limouzat Deposit, Bois-Noirs Mountains). Georges Durand (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1963. 84p.

The present work is concerned with 7 different samples taken at various levels in the Limouzat mine in the Bois-Noirs mountains. It has been possible to show that the uranium dates from 265 M. Y. and that a rearrangement occurred 65 M. Y. ago. A γ-spectrometer study which was originally intended to show the existence of the lack of balance in the radon circulation, has made it possible to show that the γ spectra recorded on various samples could be erroneous. It was observed in effect that the presence of lead, iron, etc., had a strong influence on the γ spectrum of the radium family, whereas all research workers have considered that concentrations in the uranium ore were negligible and had no significant effect on the study of the γ spectra of the samples. It is evident that an interesting study should be undertaken on the screening effects of the different cations existing in the ores. It is believed that it is possible to show the presence of certain elements directly by γ-spectrometry. The ages measured with the mass spectrometer present two types of disagreement but these have been explained by considering that there occurred a first arrival of lead followed by a rearrangement and, at certain points, a second arrival at this date. Finally, the deposit studied undergoes a circulation of uranium and of radon. (auth)

18057 (NP-13785) RUM JUNGLE PROJECT. (Australia. Atomic Energy Commission). 1963. 18p.

A report is presented on the uranium mining and treatment industry established at Rum Jungle and its contribution to the development of the Northern Territory. The Combined Development Agency contract for uranium procurement (terminated in 1963) and some of its results are described. A description of Rum Jungle and its geology and mineralization is given. Mining and treatment of ore are discussed, and some production statistics are given. (D.L.C.)

18058 ON THE OCCURRENCE OF RADIOACTIVE CHLORITE IN THE BUNDLEKHAND GRANITES. S. Viswanathan (India Atomic Energy, New Delhi). Current Sci. (India), 32: 360(Aug. 1963).

A radiometric survey in the Gwalior and Shivpurj Districts of Madhya Pradesh (India) revealed radioactivity of the order of six to eight times the background radiation over some outcrops of the Bundlekhand Granites occurring around the villages of Chitoli, Harsi, Narwar, and Dhamkan. Studies showed chlorite to be responsible for this radioactivity; this is the first record of radioactivity in chlorite in the Bundlekhand Granites. Chlorite separated from samples from the different radioactive outcrops radiometrically assayed 0.31 to 0.45% equivalent U_3O_8. The mineral shows shades of greens, yellows, and browns, the majority of the flakes being nonpleochroic due to radioactive damage and showing distinct metamictization. Autoradiographs show that most of the radioactivity of the mineral is confined to so-called blood red clouds, which resemble the well-known iron stain halos surrounding such radioactive minerals as monazite, xenotime, uraninite, thorite, allanite, and fergusonite. From the manner of occurrence of the radioactive blood red clouds, the inference is made that they were possibly formed by alteration of small radioactive inclusions in the biotites of the host rock during metasomatism of the latter with concomitant chloritization of the biotites. This view is supported by the fact that these radioactive granites display marked metasomatic effects such as albitization and carbonatization, whereas the nonradioactive types in the area do not, and show an absence of radioactive chlorites. (BBB)

18059 RADIOELEMENT DISPERSION IN A SEDIMENTARY ENVIRONMENT AND ITS EFFECT ON URANIUM EXPLORATION. R. M. Moxham (Geological Survey, Washington, D. C.). Econ. Geol., 59: 309-21(Mar.-Apr. 1964).

The radioelement content of the major part of the southeast Texas Coastal Plain sedimentary sequence falls within a range common for sandstones and shales. Exceptions to the normal limit are mainly in small, widely scattered areas. One anomalous area, however, covers several tens of square miles and contains most of the important uranium deposits. Both mechanical and chemical dispersion of radioelements takes place in the immediate vicinity of the ore deposits, though no attempt was made to extend this local dispersion model to the large, regional gamma radiation anomaly. It is suggested that the point-source concept for sedimentary uranium deposits is unrealistic and that conventional aeroradiometric survey grid spacing can be substantially enlarged without seriously reducing efficiency in uranium exploration. (auth)

18060 THORIUM AND URANIUM IN MONAZITE FROM SPOKANE COUNTY, WASHINGTON. John W. Hosterman, W. C. Overstreet, and J. J. Warr, Jr. (Geological Survey, Beltsville, Md. and Geological Survey, Washington, D. C.). p.D128-30 of "Short Papers in Geology and Hydrology. Articles 122-172." Washington, D. C., Geological Survey, 1964.

Monazite occurs in residual clay derived from granodiorite and related rocks (saprolite) and sedimentary clay deposits of the Latah Formation. In three samples of monazite separates, thorium oxide (ThO_2) averages 3.6% and uranium oxide (U_3O_8) averages 0.37%. The tenor of the monazite is not high enough to be considered commercial. (auth)

18061 FIZIKO-KHIMICHESKOE ISSLEDOVANIE USLOVII OBRAZOVANIYA URANOVYKH RUD. (Physico-Chemical Investigation of Conditions Conducive to Formation of Uranium Ores). R. P. Rafal'skii. Moscow, Gosatomizdat, 1963. 147p.

Physicochemical studies were made of the primary mineralization of uranium-bearing deposits. The crystallization of amorphous silica and the mechanism of hydrothermal transformation of silica glass to quartz under isothermal conditions are analyzed. The solubility of U(IV) and U(VI) compounds in aqueous solutions and the reduction of U(IV) and U(VI) by divalent iron, sulfur, sulfur compounds, and other reducing agents are discussed as well as the reduction and precipitation of uranium by minerals. The hydrothermal transport and deposition of uranium are also discussed. 152 references. (R.V.J.)

HEALTH AND SAFETY

Refer also to abstracts 17454, 17707, 17762, 18041, 18046, and 18048.

18062 (AED-C-02-04) AED INFORMATION SERVICE. SERIES C: BIBLIOGRAPHIES. SECTION 02: RADIATION EFFECTS ON FOOD (INCL. RADIOACTIVE CONTAMINATION). Hanna Lueck, comp. (Germany. Forschungsantalt für Lebensmittelchemie, Munich). Feb. 1964. 227p.

Eleven hundred and fifty-eight references are presented to the world literature on radiation effects on food. References to related biological and chemical studies and studies on radiation dosimetry are included. Emphasis is placed on radiation processing of foods and food products to increase storage life and the effects of fallout fission products on radioactivity in food chains. (C.H.)

18063 (ANL-6790(p.11-14)) SELF-ABSORPTION AND RECIPROCITY LAW IN RADIATION DOSIMETRY: CALCULATION OF ABSORPTION COEFFICIENT FROM MEASURED INTENSITIES OF RADIATION. Ernesto Trucco (Argonne National Lab., Ill.).

Equations are presented that were used in calculations of absorption coefficients from measured radiation intensities for radiation dosimetry. (C.H.)

18064 (HI-243-RR) SPECIAL ASPECTS OF ENVIRONMENT RESULTING FROM VARIOUS KINDS OF NUCLEAR WARS. Robert U. Ayres (Hudson Inst., Inc., Croton-on-Hudson, N. Y.). June 5, 1963. Contract OCD-62-218. 262p. (AD-409421)

Ecological aspects of a post-attack environment are considered. Emphasis is placed on radiological warfare effects on food chains, diseases and pests, and abiotic factors such as weather and soil and water conservation. Information on radiosensitivities of various organisms and radionuclide cycling are summarized. Recommendations are made pertaining to ecological factors and their influence on survival. (H.M.G.)

18065 (HW-SA-3310) NUCLEAR SAFETY STANDARDIZATION AT THE INTERNATIONAL LEVEL. M. C. Leverett (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 2, 1964. Contract AT(45-1)-1350. 11p. (CONF-460-1)

From 14th National Conference on Standards, Washington, D. C., Feb. 1964.

Problems to be expected in nuclear standardization at the international level are reviewed. The programs of the International Organization for Standardization, the International Electrotechnical Commission, and the International Atomic Energy Agency are outlined. Standards for nuclear safety adopted or proposed by these organizations are discussed. (C.H.)

18066 (LAMS-2946) HEALTH PHYSICS BIBLIOGRAPHY ON TRITIUM. Donald A. McKown, comp. (Los Alamos Scientific Lab., N. Mex.). July 16, 1963. Contract W-7405-eng-36. 87p.

A list is presented of 87 papers with abstracts on tritium toxicity. The papers were selected to cover those aspects of the subject that would be of interest to monitoring and health physics personnel involved in radiation protection work. A few bibliographies are listed. (auth)

18067 FOOD, FALLOUT, AND THE FUTURE. S. W. Waife. Am. J. Clin. Nutr., 10: 323-4(Apr. 1962).

The composition of food rations for fallout shelters is discussed. It is suggested that an intensive program to develop suitable stable foods for this purpose may result in the discovery of new means to provide useful forms of foodstuffs for underdeveloped nations. (BBB)

18068 RADIATION AND THE PUBLIC HEALTH. Donald R. Chadwick (Public Health Service, Washington, D. C.). Am. J. Public Health, Suppl., 54: 63-70(Jan. 1964).

National and local programs for radiologic health are discussed. It is pointed out that the total number of persons in the United States working on jobs in which radiation exposure is an actual or potential problem is now estimated at 500,000. At the present time, environmental contamination from the use of atomic energy consists largely of fallout from nuclear weapons testing. Public health aspects of acute and long-term effects of radiation are discussed, and it is concluded that acute radiation effects, because they are produced usually by acute large exposures, will not occur with sufficient frequency to present a significant public health problem, barring a major contaminating incident. Public health agency programs and activities should, however, place particular emphasis on protection of the public health from protracted low-level exposure to radiation and, consequently, its long-term effects. Some principles involved in establishing control programs dealing with low-level radiation are examined, especially the relation between radiation dose and biological effects. The existence or nonexistence of a threshold dose is considered, and it is concluded that there is no level of radiation exposure below which there can be absolute certainty that harmful effects will not occur to at least a few individuals when sufficiently large numbers of people are exposed. Coordination of federal, state, and local efforts to deal with radiological health problems as a major responsibility of the Public Health Service's Division of Radiological Health is discussed. (BBB)

18069 RADIOACTIVE FALLOUT IN PEACE AND WAR. Hal Hollister (Atomic Energy Commission, Washington, D. C.). Arch. Environ. Health, 8: 590-7(Apr. 1964).

There are no data on large-scale nuclear war. Nuclear weapons have been fired and most of our solid information about fallout is associated with such firings. Information also exists concerning gaseous or particulate release from atomic energy plants in normal operations. Information has been developed on the behavior of reactor components such as fuel elements when these have deliberately been stressed in the laboratory to conditions far exceeding design levels for normal operation (temperature, corrosion, etc.). Reactor accidents have been few. For a nuclear reactor accident, the ordinary physical and chemical properties of the radioactive materials released would be determined primarily by such factors as fuel element construction and materials, the presence or absence of a containing vessel around the reactor (such a vessel could be ruptured), etc., rather than by soil as for a surface nuclear weapon burst. (auth)

18070 MEASURING AND MONITORING FALLOUT RADIOACTIVITY. John H. Harley (Atomic Energy Commission, New York). Arch. Environ. Health, 8: 598-605 (Apr. 1964).

A general description of the measurements and equipment required for estimating hazard to man from radioactive fallout is presented. Emphasis is placed on the peacetime situation, but a few points are made regarding

nuclear warfare. In general, the high levels of radioactivity resulting from a nuclear war would allow hazard assessment with simple instruments, while the low levels existing in peacetime require more complex instrumentation and detailed measurements. (auth)

18071 RADIOACTIVE FALLOUT PROBLEMS IN FOOD, WATER, AND CLOTHING. Merril Eisenbud (New York Univ., New York). Arch. Environ. Health, 8: 606-12(Apr. 1964).

The problems of food, water, and clothing in the post-attack period in the event of nuclear war would be dominated by the influences of blast and fire with radioactivity contributing in a lesser way. The principal effect of radioactivity on food supplies would probably result from lethal radiation effects on livestock. Major losses of food supplies would also result from the extensive fires which would occur on a national scale following a major nuclear attack. Fresh foods that survive the initial effects and which can be delivered to the consumer before rotting, would probably be heavily contaminated with ^{131}I for a few weeks after the attack. The dose to the thyroid from ingested ^{131}I is likely to be the limiting factor on the amount of radioactive contamination the population can tolerate. Exposure of the intestinal lining to intensively radioactive particles ingested with food may also be a limiting factor. Compared to these sources of exposure, Sr^{90} would be far less of a threat. Radioiodine would also be the limiting factor in determining the amount of radioactive contamination that is permissible in water. (auth)

18072 THE PROBLEM OF NUCLEAR SHELTERS. Robert L. Corsbie (Rose, Beaton, Corsbie, Dearden and Crowe, New York). Arch. Environ. Health, 8: 613-21 (Apr. 1964).

The rationale for the development of civilian defense in the U. S. is reviewed. The effects of nuclear weapons are summarized for various blast parameters, distances, and areas. Biological effects of radiation and the protection afforded to the population by shelters in the event of radiological warfare are discussed. Protective criteria for shelters are outlined. The need for advance preparations is stressed. (C.H.)

18073 DOSE OUTPUT OVER A UNIFORMLY IRRADIATED AREA. H. Eisenlohr and Kh. Thiesbuerger (ABC-Abwehrschule, Sonthofen, Ger.). Atomprazis, 10: 80-3 (Feb. 1964). (In German)

The gamma dose output caused by residual radiation from radioactive precipitation, and which can be expected for a given area following a nuclear explosion, was calculated under simplified conditions. (auth)

18074 THE PROBLEM OF CALIBRATION IN MEASUREMENT OF TOTAL-β-ACTIVITY FOR MONITORING PURPOSES. K. Haberer (Technische Hochschule, Karlsruhe, Ger.). Atompraxis, 10: 98-104(Feb. 1964). (In German)

In ordinary measurement setups, the efficiency of β-activity measurement in various radionuclides is registered as a function of the layer thickness of the sample. By comparing the results thus obtained with the equivalent curves for the β sources potassium-40 (in natural potassium compounds) and thallium-204, which are frequently used for calibration purposes, the errors emerging from this comparison with standard sources can be ascertained. Comparison also shows that potassium-40 is better suited for calibrating fission-mixture samples. Correction factors in potassium calibration are given for two frequently used measurement setups, and are examined by comparative measurements, using the absorber method. (auth)

18075 THE INCIDENCE OF THYROID CANCER IN ENGLAND AND WALES. H. Campbell (Welsh National School of Medicine, Cardiff, Wales), W. R. S. Doll, and Judith Letchner. Brit. Med. J., 2: 1370-3(Nov. 30, 1963).

In autumn 1961, test explosions of nuclear weapons released into the atmosphere a measurable amount of radioiodine, some of which found its way into food. The measured concentrations of ^{131}I in the thyroids of 20 adult subjects indicated that the glands received ~7 mrad from this source during the three months in which atmospheric activity could be detected. The dose received by children must have been greater, because of the greater consumption of cow's milk. An attempt was made to measure the incidence of the disease before the occurrence of fallout from the available data. Comparison between the mortality for England and Wales, and that for the U.S.A. white population, shows that the rates for persons are closely similar at age 35 yr and over; at younger ages the American mortality is appreciably higher. The higher American mortality in youth may be attributable to the greater use of radiotherapy for benign conditions in childhood. A survey of data obtained from three studies in the U.S.A. shows a similar change with age in the ratio between mortality and incidence. The ratio is somewhat lower at ages 20 to 69 years in the U.S.A., suggesting that the incidence in England and Wales may be slightly underestimated. (BBB)

18076 CONTAMINATION AND DECONTAMINATION OF BREAD GRAINS. H. D. Ocker. Brot Gebaeck, 17: 111(June 1963). (In German)

The decontamination of radioactively contaminated grain and grain products is discussed. Two methods of decontamination are proposed: removal of the grain husk by the so-called wet-peeling method and production of low-ash flour. (M.C.G.)

18077 IONIZING RADIATION AS AN INDUSTRIAL HEALTH PROBLEM. R. B. Trewin (Hydro-Electric Power Commission of Ontario, Toronto). Can. Med. Assoc. J., 90: 20-3(Jan. 4, 1964).

The history of the discovery of radioactivity and its applications, especially to industry, are reviewed, with consideration of the hazards involved. The radiation problems encountered by the industrial physician are discussed. The radiation protection program of the Hydro-Electric Power Commission of Ontario is outlined. (BBB)

18078 FLEXIBLE FOOD PLANS FOR DISASTER SITUATIONS. Irene Bartholomew (Rochester Methodist Hospital, Rochester, Minn.). Hospitals, 37: 80-8(May 1, 1963).

Planning for food service in hospitals in event of a thermonuclear attack or other civil catastrophe is discussed. Disasters of three different scopes or magnitude are considered: disaster small in scale relative to the size of the hospital; a nuclear fallout period when the hospital would be used as a shelter; and an emergency that would fill the hospital to its greatest capacity. It is pointed out that nutrient requirements may be less important than psychological requirements of shelter occupants. Plans for food utilization are outlined and possible menus are offered for various emergency conditions. (BBB)

18079 AHA STATEMENT ON CIVIL DEFENSE SHELTER PROGRAM. Hospitals, 37: 198-212(Sept. 16, 1963).

The statement on the Civil Defense Shelter Program, H.R. 3516, was presented by the American Hospital Association (AHA) before the Subcommittee No. 3 of the House Committee on Armed Services on June 20, 1963. The role that AHA has assumed in the preparation of hospitals for

natural and nuclear disasters is outlined and AHA's support to legislation that would authorize federal funds to assist hospitals in providing approved public shelter space is offered. The efforts of AHA in civil defense preparedness are outlined. After considering the situation in the event of an all-out attack, it was decided that hospitals would be concerned particularly in six areas of activity: man-power, supplies and equipment, construction, financing, patient care, and communications. Subcommittees were then appointed to deal at length with each of these areas and to develop a policy and procedures to be followed by hospitals in the event of nuclear attack. It was concluded by AHA that national survival could best be obtained by providing for the protection of as large a segment of the public as possible. To this end, AHA has urged hospitals to participate in the public fallout shelter program to the fullest extent possible. It is believed that some hospitals may be able to adapt existing facilities for shelter purposes with modest expenditures. However, to expand the capabilities for many hospitals for public shelter space, basic changes in exisiting structures or new construction may be necessary. AHA determined that the maximum federal allotment of $2.50 per ft^2 is not sufficient and would necessitate hospitals obtaining very substantial amounts of money on their own in order to undertake the necessary shelter space construction. AHA urges, therefore, that the Congress reconsider the maximum of $2.50 of federal matching presently proposed, and questions whether this amount is sufficient to defray the cost of adapting enough space for shelter purposes in hospitals. This amount would not constitute a sufficient federal contribution to stimulate the development of new shelter space. The need for a single civil defense authority is also proposed. (BBB)

18080 MEXICAN ^{60}Co RADIATION ACCIDENT. Gould A. Andrews (Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.). Isotopes Radiation Technol., 1: No. 2, 200-1(Winter 1963-64).

Exposure of a Mexican family to an unshielded 5-C ^{60}Co source from March to July 1962, is discussed. The deaths that resulted from this radiation exposure are described. (M.C.G.)

18081 WHEN DO YOU LEAVE A FALLOUT SHELTER. Marshall Brucer. J. Am. Med. Assoc., 180: 144-6(Apr. 14, 1962).

A simple means for detecting unsafe levels of fallout, which would result from a thermonuclear explosion, is described. In the absence of more accurate metering devices, this would aid in determining when fallout shelters could be left. The sources, characteristics, and types of fallout are briefly discussed, and the effects of blast and thermal, neutron, and γ radiation produced by a nuclear explosion are enumerated. The radioactivation of various elements in the human body exposed to such an explosion by the released neutrons is considered. (BBB)

18082 MANAGEMENT OF MASS CASUALTIES: RESUME OF COURSE TAKEN AT THE MEDICAL FIELD SERVICE SCHOOL, BROOKE ARMY MEDICAL CENTER, FT. SAM HOUSTON, TEXAS. Alma Dea Morani (Woman's Medical Coll. of Pennsylvania, Philadelphia). J. Am. Med. Women's Assoc., 17: 134-6(Feb. 1962).

An outline is presented of the U. S. Army Medical Corps 5-day course on management of mass casualties which might result from thermonuclear war or other civil disaster. Basic rules for survival in the event of a disaster are given, as follows: recognition of dangerous conditions and taking of preventive measures; preparation for the event, which includes instructions on what to do when it occurs; heeding warning of alert signals and obeying instructions; making proper use of preparations made; being able to determine when danger is over; proper care for injured and removal of dead; and restoration of livable conditions as soon as safely possible. Subjects of particular interest to the civilian physician were presented. Sorting of casualties is discussed. Civil defense planning at the local, community level is also discussed. (BBB)

18083 FAST FRACTURE OF PRESSURE VESSELS: AN APPRAISAL OF THEORETICAL AND EXPERIMENTAL ASPECTS AND APPLICATION TO OPERATIONAL SAFETY. W. H. Irvine, A. Quirk, and E. Bevitt (United Kingdom Atomic Energy Authority, Risley, Eng.). J. Brit. Nucl. Energy Soc., 3: 31-48(Jan. 1964).

Fracture mechanics are described and the significance of these in relation to the failure of pressure vessels and current material testing methods are considered. The theoretical ideas were used to design and plan an experimental program. Implications of the experimental and theoretical work in relation to the operational safety of reactor pressure vessels are discussed. It is shown that the current concepts of crack arrest temperature and the form of operational inspection, including material monitoring programs, need to be critically reappraised in the light of this work. (auth)

18084 SOME MEDICO-LEGAL PROBLEMS ASSOCIATED WITH ATOMIC ENERGY. K. P. Duncan (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). J. Brit. Nucl. Energy Soc., 3: 49-52(Jan. 1964).

Absolute liability; nonthreshold theory in radiological protection; permissible levels; radioinduced diseases; diagnostic and other problems; statistical approach; and the importance of the problem are discussed. Education is stressed as the factor that alone can contribute to the solution of the overall problem of acceptance of the nuclear industry by the general public and by all the guardians of society on the same basis as the more traditional industries and activities of the country are accepted. (P.C.H.)

18085 PHYSICAL ASPECTS OF RADIATION. Howard B. Latourette (State Univ. of Iowa, Iowa City). J. Iowa State Med. Soc., 52: 399-403(July 1962).

Preliminary to a discussion of protective measures for civilian populations exposed to thermonuclear attack, the nature and effects of radiation are discussed. Protection against fallout is considered, and as a model problem the possible extent of fallout across Iowa from a detonation over the Omaha area, the location of Strategic Air Command headquarters and several missile bases, is projected. It is concluded that under certain circumstances, in certain locations, fallout shelters might be very valuable and make the difference between life and death for the occupants. However, it is noted that present estimates of the value of fallout shelters are predicted on our current understanding of technologic developments, and that within 5 or 10 years they may again need to be completely revised. (BBB)

18086 THE PHYSICIAN AND FALLOUT. Seymour Charles (Newark Beth Israel Hospital, N. J.). J. Newark Beth Israel Hosp., 13: 331-41(Oct. 1962).

Criticisms are advanced against official attitudes and statements which are alleged to minimize the effects of fallout on present and future populations, and the responsibilities of the physician in assessing somatic and genetic effects of fallout are discussed. It is proposed that there has been a remarkable and uniform silence from practically all segments of American medicine regarding any possible

health hazard from fallout, and that whenever a statement is issued, it is usually prepared to dilute an concern. It is suggested that many physicians have thought that there is no problem, and others have assumed that only authorities with access to confidential and specialized information can arrive at any intelligent conclusions. Lack of knowledge of the possible deleterious effects of fallout radionuclides is emphasized, and it is pointed out that some nuclides with short half lives, other than those generally considered to be most hazardous, may contribute over half of the background radiation. Standards on the determination of minimum permissible levels are considered. It is suggested that in considering genetic effects the many statements of the absence of genetic effects in radiation-exposed populations of Hiroshima and Nagasaki should be examined. Hazards of high levels of ^{131}I in milk are emphasized, and possible preventive steps weighed. It is concluded that physicians should participate in programs of information and education to both professional and lay groups, and that there will be less confusion and complacency when the American medical profession better understands the challenge involved in radiological health. (BBB)

18087 INDUSTRY'S ROLE IN CIVILIAN DEFENSE. Harry G. Becker. J. Occupational Med., 5: 297-300 (June 1963).

The preparation and organization of civil defense at the industrial level are discussed. (BBB)

18088 THE NEUTRON HAZARD. J. A. H. Brown (Medical Research Council, Harwell, Berks, Eng.). J. Roy. Army Med. Corps, 107: 99-102(Apr. 1961).

The neutron hazard associated with the possible use of a small nuclear weapon, for a tactical role and a yield in the sub-kiloton range, is discussed. It can be used on the battlefield and because of its low yield its effect is felt only up to several hundred yards' radius. The heat and blast effects extend for a shorter distance than the ionizing radiation, and the radiation differs also from that of other nuclear weapons in that neutrons are a more important component than γ rays. Radiobiologic differences of neutrons and gamma rays are identified. Rodents receiving neutron irradiation and surviving the acute stage develop a high incidence of tumors of the gastrointestinal tract, which points to some special effect of neutrons on the gut, and cells of the duodenal epithelium of mice show, after neutron radiation, very much less recovery than after x rays. It appears that neutrons produce a very much larger number of chromosome breaks that cannot be repaired and the cells die. Mitosis is much delayed. This leads to disintegration of the crypts in the intestine and disorganization of the villi. Where the original crypts have disintegrated, masses of chromatin fragments accumulate in the crypt spaces, and where new crypts are slow in forming, the covering of mucous cells sloughs off. Also discussed are the problems of the medical officer faced with the treatment of gastrointestinal radiation casualties in the field after small tactical weapons are used. If the radiation dose is predominantly due to neutrons and is not too high, such casualties may not necessarily suffer bone marrow failure and failure of immunity later. (BBB)

18089 NIHON—THE LAND OF THE RISING SUN. John F. Wilkinson. Manchester Med. Gaz., 42: 8-16(1963).

A survey of present conditions in Hiroshima and Nagasaki is presented, and the pathologic sequelae arising in atomic bomb survivors are reviewed, with particular reference to the findings of the Atomic Bomb Casualty Commission (ABCC) in Hiroshima. The function, facilities, and staff of the ABCC are also discussed. Present evidence of bomb damage to the city is described, as well as the extent of reconstruction (which is illustrated). (BBB)

18090 RADIOACTIVITY IN SEWAGE DISPOSAL SYSTEMS FROM INDUSTRIAL AND MEDICAL WASTES AND FALLOUT. T. R. Folsom and G. J. Mohanrao. Mater. Res. Std., 4: 69-73(Feb. 1964).

A nationwide study was made on radioactive material in sewage. Although no hazardous condition owing to radioactive material was observed, routine monitoring of sewage is stressed. (P.C.H.)

18091 A SIMPLE METHOD OF INTERPOLATION OF DOSIMETRIC DATA IN PLOTTING ISODOSES FOR MULTIFIELD IRRADIATION. V. A. Kvasov and B. V. Astrakhan (Gertsen Research Inst. of Oncology, Academy of Sciences, USSR). Med. Radiol., 9: No. 2, 89-93(Feb. 1964). (In Russian)

The distribution of the absorbed energy in distance irradiation is usually described by means of isodose curves with relative change of the dose by 10%. A method for determining the dose in areas situated between two isodose curves is proposed. A description is also given of the technique and devices facilitating the dose calculation in these areas. The referred to method is employed for the compilation of total isodose schemes in multifield irradiation. (auth)

18092 CASUALTIES FROM NUCLEAR WEAPONS. III. THE INTERNAL RADIATION HAZARD. F. C. Pace and W. R. Waters (Dept. of National Health and Welfare, Ottawa). Med. Serv. J. (Can.), 19: 427-45(June 1963).

Fission products of major biological significance are discussed, and the critical organ for and radiologic and biologic half lives of ^{89}Sr, ^{90}Sr, ^{131}I, ^{137}Cs, and ^{140}Ba are tabulated. Entrance of radionuclides into the biosphere via four pathways (soil, foliar, floral, and plant-base) is exemplified by reference to radiostrontium. Fallout contamination of drugs and other medical supplies is also considered. The hazards of fallout, the typical lesions produced by early and late fallout, evaluation of the internal hazard, prevention of contamination, and decontamination measures are reviewed. Rules are presented as a practical guide for the early times after attack. Among other problems discussed are: criteria for administering blood transfusions to irradiated persons and protection of x-ray film from fogging by fallout. (BBB)

18093 CASUALTIES FROM NUCLEAR WEAPONS. IV. APPENDICES AND BIBLIOGRAPHY. A MANUAL FOR EMERGENCY HEALTH SERVICES, CANADA. F. C. Pace and W. R. Waters (Dept. of National Health and Welfare, Ottawa). Med. Serv. J. (Can.), 19: 531-76(July-Aug. 1963).

Appendices are provided on the following aspects of civil defense: nuclear detonation and fallout reporting system; advantages and disadvantages of the indoor location under nuclear attack; operational control of radiation exposure levels in civil defense operations; a classification of existing hospital locations outside target areas in relation to probable radiation dosages after an attack on North America; radiation detection instruments; levels of contamination; protection against the contact hazard by personal cleansing; protection against the contact hazard by clothing; management of clothing and other fabrics contaminated by radioactive fallout; contamination of drinking water by radioactive fallout from nuclear weapons (rules for survey and management); contamination of human food stocks by radioactive fallout from nuclear weapons (rules for survey and management); contamination control for drugs and material medica; management of vehicles contaminated

by radioactive fallout; tables for use in the solving of problems related to dose rates and dosages of fallout γ radiation; the calculator Radiac No. 1; data for high-yield weapons; and reduction of fallout radiation hazards in health installations. Problems pertinent to these topics are outlined, extensively discussed, and recommendations made for extending knowledge in certain areas where present data are incomplete. A bibliography citing 40 monographs, symposia, and selected articles on civil defense is also provided. The Radiac Calculator, which is described and illustrated, is a simple, circular slide rule designed to solve various problems connected with the dose or dose-rates resulting from mixed fission products. Extensive information for use in improving shielding of hospitals and other aid facilities is given. Protective characteristics of various building materials are compared. A method of comparing the attenuating capacity of different types of materials used in buildings, so that the sum of their effects may be expressed as a single figure, is described. The unit employed for this purpose is the mass thickness, which for a wall or roof is the sum of the mass thickness of each of the components. The mass thickness is given for various material as the wt per sq ft. Various aspects of the protective qualities of a building are considered, and application of these principles to a 50-bed hospital is analyzed in detail. (BBB)

18094 REFLECTIONS OF HIROSHIMA. John J. Robinson (Veterans Administration Hospital, Lake City, Fla.). Med. Times, 89: 645-8(June 1961).

Reactions and adjustments of Hiroshima residents subsequent to 1945 are discussed by a pathologist formerly with the Atomic Bomb Casualty Commission in Hiroshima. (BBB)

18095 RADIATION PROTECTION IS EMERGENCY PROBLEM. Arlene M. Putt and Richard J. Hinds (Univ. of Michigan, Ann Arbor). Mod. Hosp., 98: 118-20(Apr. 1962).

The adaption of hospital emergency rooms to handle patients accidentally contaminated with radioisotopes is described. This presentation includes a plan and flow chart to receive, screen, decontaminate, and treat patients who have been exposed to uncontrolled radiations. (BBB)

18096 NEW HOSPITAL DIGS IN FOR FALLOUT SAFETY. A. Chester Conrow and Jack A. White (St. Barnabas Medical Center, Newark, N. J.). Mod. Hosp., 100: 112-13(Mar. 1963).

A description is given of the design of the St. Barnabas Medical Center, under construction in Livingston, N. J., which will incorporate two floors designed to provide protection from radioactive fallout. On these first two floors of the six-story building are located all of the basic services and professional facilities plus 75 patient beds. Each floor covers approximately 2.5 acres, and the entire shelter area can accommodate 1100 persons for a minimum of 14 days. Location of the building on a hillside takes advantage of both excavation and backfill to provide protection for the ground floor, 95% of which is actually underground. Specially designed baffle walls were used also to protect primary exits and entrances to the shelter area so it can function as a hospital during normal operations. Service and ambulance entrances allow trucks and ambulances to be driven in under cover and decontaminated before they are unloaded. The shelter will have available at least 750 tons of air conditioning capacity. All air intake units are equipped with a combination of continuous mat filters and electrostatic filters to remove radioactive particles from the air. To make the entire hospital safe from any type of gas warfare, the ventilation and circulation ductwork is designed to accept special filters and additional booster pumps. To ensure a continuous and uncontaminated source of water, an 800-ft well was driven to produce in excess of the 200 gal/min required to operate the shelter area. A large area has been allocated to primary and secondary storage of supplies of all types: food, linens, drugs, medicines, and surgical instruments. The central supply room is equipped to produce parenteral solutions in an emergency. The cost of incorporating the shelter in the hospital will be more than $500,000; $400,000 of this will be met by the Office of Civil and Defense Mobilization. (BBB)

18097 RADIATION DOSE IN DENTAL ROENTGENOGRAPH, WITH SPECIAL REFERENCE TO ENLARGEMENT DENTAL RADIOGRAPHY. Takashi Kitabatake, Masao Kaneko, Yoshio Takagi, and Dan Kawai (Nagoya Univ., Japan). Nagoya J. Med. Sci., 24: 234-41(Mar. 1962).

Dosimetry was used to estimate the radiation dose received by dental patients and dentists in dental clinics in Japan, and the results were compared with those obtained by an enlargement technique. The phantom of paraffin used for measuring exposure doses was based on a whole-body plaster of paris cast of a Japanese of medium size. The lungs in the phantom were made of cork with a specific gravity of 0.2, and three holes were constructed in the oral cavity, lower abdomen (ovary region), and testicular region for insertion of a dosimeter. Since in most dental clinics in Japan the x-ray apparatus is installed in the corner of the treatment room without any Pb protection, dose distribution of scattered x rays was also surveyed. Four types of x-ray units were used, and measurement was performed at distances 50 to 200 cm at levels of 50 and 100 cm from the floor. The gonads received a dose of about 0.5 to 3 mr per exposure in males, and 0.03 to 1 mr in females. Patients received radiation doses of 10 to 1000 mr per exposure at the eye lens, 1500 mr on the nasal apex, and 500 mr on the thyroid region. Not less than 100 mr of radiation was distributed in the regions of the pharynx and cervical spine. For dentists holding the film in the patient's mouth, about 1 to 3 r were received per exposure. They also received whole-body irradiation of scattered rays of about 500 to 2000 mr/hr. Since in Japan, even at present, the dentist usually holds the film in the patient's mouth during radiography, and if he conducts dental radiography 10 times a day, he should receive 10 to 30 r on his hands a day, or 3000 to 9000 r a year. Furthermore, the dentist standing near the patient is exposed to scattered rays of about 1.4 mr per exposure. Therefore 11 exposures per day give the upper limit of irradiation dose according to maximum permissible dose. The long-cone method, it is suggested, is of value not only for making enlargement radiograms but also for diminishing the exposure dose of dentists since it prevents the production of scattered rays. (BBB)

18098 STRONTIUM-90 AND CESIUM-137 IN MILK AT ISPRA, ITALY, DURING 1960-62. M. De Bortoli, P. Gaglione, A. Malvicini, and E. Van Der Stricht (C.C.R., Euratom, Ispra, Italy). Nature, 201: 1175-7(Mar. 21, 1964).

Results obtained by routine radioactivity analysis of milk samples obtained monthly (1960–1962) from four dairies near Ispra, Italy, are presented. Regular checks were also made of milk produced in an extensive zone of irrigated pastures near Milan. Observed ratios (S.U. milk/S.U. diet), the S.U./K.U. ratio [(pC ^{90}Sr/g Ca)/(pC ^{137}Cs/g K)], and the relative contributions of direct and indirect contamination to the radioactivity of milk are discussed. (H.M.G.)

18099 IODINE-131 FALLOUT IN MILK. R. J. Garner. Nature, 201: 1274-5(Mar. 28, 1964).

Validity of the relation, derived by Dr. H. A. Knapp from measurements on the Small Boy burst, between the γ radiation from fission products deposited 24 hr after detonation and the maximum ^{131}I concentration in milk is extended to cover the radiation dose received by the thyroid glands of people drinking fresh milk. (H.M.G.)

18100 MEDICAL RADIATION EXPOSURE. Richard H. Chamberlain (Univ. of Pennsylvania, Philadelphia). New Physician, 11: 295-7(Sept. 1962).

A discussion is presented of epidemiological estimates of dosage values; control and improvement measures including educational, regulatory, and research; and perspectives in medical exposure. In the United Kingdom the average gonadal exposure per year for medical purposes is between 15 and 25 mrad. Figures from other western European countries range from about 25 to 60 mrad and the Japanese estimate is about 40 mrad. In the U. S., exposures are probably closer to 25 to 50 mrad/yr than the preliminary estimate of 150 mrad. Figures for somatic exposure are likely to be roughly comparable to those for gonadal exposure. All studies of radiation exposures have shown that, whatever the dosage figures may be, there should be improvement by reduction of exposure required for the procedures that are being done and also in the choice of procedures. Findings of a survey of the American College of Radiology are discussed. The survey made by the College indicates a considerable increase in the amount of information available to physicians on radiation protection and that most physicians have improved their use of radiation appreciably during the past five years. The College survey covers 5000 of its members, 54 state and regional medical societies, and 87 medical schools, with a nearly 50% response of its members. The societies showed an improvement of 50 to 75% in the quantity of radiation protection data available to their members through articles and talks before medical meetings. Every society responding has a committee on disaster planning to deal with problems inherent in atomic disasters, military or otherwise. The 78 medical schools reporting indicated that medical students receive an average of 4.4 hr of instruction directly dealing with radiation protection and that paramedical personnel get one to 10 hr. Only four schools had no formal instruction in protection. Forty-five schools showed an increase by half or more in the radiation material presented during the past 5 yr. The activities of state and other regulatory bodies concerned with radiation protection are discussed, as well as recent research developments which may aid in lowering patient exposure in diagnostic radiology. (BBB)

18101 EXPERIMENTAL STUDY OF SMEAR SURVEY. Yoshikazu Yoshida, Yukio Sasaki, Mikio Murata, Shoji Izawa, and Yoshio Ikezawa (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 6: 77-81 (Feb. 1964). (In Japanese)

A smear survey was performed under various experimental conditions, and the results obtained were compared with those of field tests. Non-permeable surface materials such as vinyl sheet were contaminated with various radioisotopes and smeared. The experiments showed that 50 ~ 80% of loose contamination and about 50% of total contamination were detected in the model experimental conditions. On the other hand, the same experiments were also carried out using permeable materials. In this case, 50 ~ 80% of loose contamination and 2 ~ 50% of total contamination were detected. From these results, it was possible to estimate the amount of surface contamination, by assuming that 10 and 50% of the amount of total contamination are transferred to the smear disk for permeable and non-permeable surface materials with contaminants, respectively. (P.C.H.)

18102 THE PROBLEM OF THE MEASUREMENT OF RADIOACTIVE CONTAMINATION OF PERSONS WORKING WITH LUMINESCENT PAINT. P. Wenger (Centre de Radioactivité Médicale, Geneva). Oncologia, 16: 187-95 (1963). (In French)

A single sodium iodide crystal, using a 256-channel analyzer, can measure as little as 3×10^{-4} μC of Ra within 15 min in persons who have worked with luminescent paint, with an accuracy of ±20%. Use of a single crystal necessitates angular viewing of the patient, but if the patient reclines in a tilting chain the geometric arrangement that results is almost independent of the size and shape of the body, and also it has the advantage of being independent of the nonuniform distribution of Ra in the skeleton. Although sensitivity can be increased by measurement with large crystals, this raises the problem of exclusion of external radiation from cosmic rays and of secondary radiation from the walls of the chamber. For these reasons the subject must be measured within a chamber that provides protective shielding. The most practical chamber is one constructed with Fe walls ~18 in. thick. Iron can be machined easily, and it is sufficiently dense to shield out radiation effectively. The actual level of radioactive contamination of the Fe used should be checked, because radioactive Co may be introduced during its fabrication. In order to absorb secondary radiation that may be emitted from the Fe, the entire interior wall surface of the chamber should be lined with a thin layer of Pb, and then a layer of Cu and of Cd. The chamber at this laboratory is constructed from steel rails fabricated prior to 1930 that contain no radioactive contamination. The chamber itself is 2 m high, 3 m long, and 2 m wide, and the walls are 18 in. thick. The inner faces of the walls are covered with a 2-mm-thick layer of Swedish Pb that is very low in radioactivity content. The chamber is located immediately adjacent to an anteroom where the patients are prepared for the measurements. (BBB)

18103 EFFECTS OF ATOMIC RADIATION ON VISION. Wilson M. Greene. Optometric Weekly, 53: 2347-52 (Nov. 29, 1962).

The known effects of nuclear explosions on the retina are discussed in terms of the eye lesions to be expected among survivors of a thermonuclear attack. Studies of rabbits during explosions of small atomic bombs showed that the retinas were burned when they were as far as 42 miles from the point of detonation. The blink reflex of the eye takes about $^1/_{10}$ sec and is too slow to afford protection from any of the three main causes of ocular injuries: effects of short-wave radiation; effects of intense, visible light and long-wave radiation; and effects of flying debris and falling structures, as well as blast effect upon the individual. It is suggested that the American people have not been adequately told how to react to a nuclear blast, and that with 260 weapons detonated, as in some attack estimates, a substantial portion of the people would be attracted to a flash of light and naturally glance toward it. The biomedical project of the Teak and Orange tests showed that a very high-altitude nuclear explosion can be particularly damaging to the eye due to the rapid rate at which the power pulse delivers thermal energy, and because of the relatively low atmosphere attenuation encountered. A high-altitude detonation in the mt yield range,

such as Teak, delivered a great percentage of its thermal energy during a small fraction of a sec after the detonation. Consequently, with a blink reflex time of just over ¼ sec for the rabbit and less than a ¼ sec for man, nearly all of the radiant exposure from a very high-altitude burst is received by the retina before the eye can be protected by blinking. This is in contrast to low-altitude detonations of the same size where the power pulse is much slower in over-all delivery of its thermal component and where the blink reflex can produce a measure of protection. Rabbits placed at distances up to 300 miles from the point of detonation developed small retinal burns, and burn diameters correlated with distance from the burst with progressively smaller lesions being encountered at increased distances. For example, the burn lesions were ~2 mm in diameter at about 40 miles distant, decreasing to 0.5 mm at 300 miles. Various other tests conducted during nuclear detonations are described and their results summarized. Thermal effects of a nuclear detonation on the eyes are also considered. Thermal radiation can cause temporary or permanent blindness from the intense light. It takes about 1 sec for the thermal output from a 1-Mt detonation to reach its peak intensity, and about 3 sec for a 10-Mt detonation to reach its peak intensity. Evasive action must be taken almost instantly if it is to be effective. Temporary or permanent blindness could be caused by the thermal radiation if a person is looking in the general direction of the fireball at the precise moment of detonation. The lens of the eye focuses heat as well as light rays on the retina of the eye. Thus, in addition to temporary or flash blindness of a few seconds or minutes duration from the intense light, actual burns of the retina could occur from undue amount of thermal radiation entering the eye. (BBB)

18104 METHODS FOR REDUCTION OF RADIATION INJURY IN X-RAY DIAGNOSIS. H. Mohr. Radiol. Diagnost., 3: 239-43(1962). (In German)

X-ray diagnosis contributes an average annual radiation dose that is equal to ~15% of the normal environmental radiation. Much of this additional radiation adds to the radiation dose to the gonads. Because radiation dose is a quadratic function of the field size, the smallest radiation field possible should be used. The effects of the electric characteristics of the equipment used are not so direct. The better the adaptation and the filtration of the radiation cone, the better the results of the radiation. Since the voltage used depends on the optimal filtration, a supplemental filter of 2 to 4 mm of Al should be used. If the gonads are located directly in the beam, the highest voltages possible should be used. Increased filtration also gives an additional advantage. If the gonads are located outside of the beam, the gonadal dose cannot be reduced by increasing the voltage used, but the filtration will still reduce the dose. This is because the energy of the scattered radiation increases with increasing radiation energy. However, if the radiation cone is located farther away from the gonads, the dose is reduced. A three-phase voltage apparatus should be used, because with pulsed voltage the long wave fraction of the radiation gives a poor image, but increases the dose to the patient. A depth shield will ensure that the film size will be optimal. A shield close to the objective is especially important in serial studies where errors can occur during the frequent centering that is required. Many photographic errors can be reduced by using automated equipment. An ionization chamber apparatus that measures the dose administered directly can be very useful. An image intensifier can help to improve orientation and reduce exposure times. One approach to improved photography is magnetic recording. This permits a picture to be obtained in $\frac{1}{30}$ sec that can be viewed or rephotographed. By combined use of an image intensifier and a 70-mm camera the dosage can be reduced to $\frac{1}{20}$ of the amount ordinarily required without this equipment. (BBB)

18105 THE EFFECT OF ENVIRONMENTAL RADIATION AND THE VALUE OF THE MAXIMAL PERMISSIBLE DOSE. H. Muth and E. Oberhausen (Universität des Saarlandes, Homburg/Saar, Ger.). Radiologe, 2: 361-8(Oct. 1962). (In German)

Environmental radiation results from cosmic rays, from radioactive materials in the surface of the earth, in air, and in construction materials. The intensity of cosmic radiation increases with the geomagnetic latitude and the distance above sea level. Much of the environmental γ radiation is produced by radioactive decay products of the Ra and Th series, as well as by ^{40}K. Some radiation exposure results from incorporation of these radionuclides into the body by way of air, drinking water, and foodstuffs. Whole-body counter measurements show that ^{40}K concentrations are related partially to age and sex. Unlike ^{40}K, most of the ^{226}Ra is incorporated into bone. Most radiation effects on bone are caused by the long-lived decay products of Rn. The body distribution of metals of the Th series is similar to, but less than, that of ^{226}Ra. The present value of the maximum permissible concentration (MPC) is applicable to chronic radiation exposure or small radiation doses intermittently administered. Because of their differences in sensitivity to radiation, values of the MPC have been established separately for blood-forming organs, gonads, and lens of the eye; skin and thyroid; and other organs. Additional considerations are applied to the exposure of particular groups of persons. One such group is radiation workers, who are limited to an average permissible weekly dose of 0.1 rem, and to a rate of dose accumulation that does not exceed 3 rem for any single dose. Dosages to the hands, arms, and feet may exceed those permitted for the first two organ groups mentioned above. The radiation hazard to the general population of childbearing age is more related to the possibility of genetic damage than to the possibility of somatic damage. (BBB)

18106 CONSIDERATIONS ON HYGIENIC ASPECTS OF RADIOACTIVE CONTAMINATION OF WATER AND SEWAGE. Antonio Tizzano (Università, Siena, Italy). Resenha Clin.-Cient., 31: 7-12(Jan.-Feb. 1962). (In Italian)

Contamination problems are reviewed. The effect of total dose of radiation is discussed, after a discussion of the increase over natural background in recent years in various locations. Distinction is drawn between immediate effects and delayed effects. Examples are drawn from cases in Hiroshima and Nagasaki and from cases due to exposure to x rays in therapy; particular effects are briefly cataloged. These include cataracts, anemia, leukemia, premature death, cancer, and birth of deformed or dead infants. In addition, research on the genetic effects of radiation is mentioned. Discussion is outlined for the problems of disposal of radioactive gases, liquid samples of both large and small volume and concentration, and solid samples. (BBB)

18107 PROBLEMS OF FOOD SUPPLY AND SANITATION IN DISASTER. Sanitarian's J. Environ. Health, 25: No. 6, 423-32(May-June 1963).

It is assumed that in initial enemy attack with thermonuclear weapons, an attempt will be made to deal a knockout blow; it is further assumed that biological and chemical

warfare weapons, coupled with sabotage may be used. Nuclear weapons will subject food supplies to the effects of blast, heat, and radiation, either induced or from fallout. Chemical and biological agents will complicate food salvage and decontamination procedures. In the development of practical plans to cope with the multiple food problems, emphasis should be given to salvage procedures for typical types of food and disposal methods for dangerously contaminated food supplies and wastes. (Public Health Eng. Abstr; 44: No. 3 (Mar. 1964))

18108 METHODS OF MEASURING PERSONNEL DOSES IN SUBJECTS WORKING WITH IONIZING RADIATION. M. Budesinska and J. Boucek (Charles Univ., Prague). Sb. Lekar., 64: 61-8(1962). (In Czech)

The efficiency of personnel dosimeters was checked. In new pocket ionizing chambers, which are described, reproducibility was ~15%, in selected chambers 5%. With pencil dosimeters the reproducibility of measurement for ^{60}Co γ radiation was 7%. With film dosimeters the reproducibility averaged 20%, because it was impossible to select, in advance, films of identical sensitivity. Also described are some measurements with a simple photometer and with a dosimeter with an electrometric tube (2N E 9) signaling when a preselected dose is exceeded. (BBB)

18109 DECONTAMINATION OF POTATO TUBERS CONTAINING CESIUM-137. Harold J. Perkins and G. Strachan (Canada Agriculture Research Station, Lethbridge, Alberta). Science, 144: 59-60(Apr. 3, 1964).

Stirring for 16 hr at 26 to 35°C of peeled and sliced tubers in a solution consisting of 1.2% KCl and 0.16% NaCl and containing a cation-exchange resin in the mixed K^+, Na^+ form effected ^{137}Cs removals exceeding 95%. Neither nutritional value nor palatability of the tubers was adversely affected. (auth)

18110 IODINE-131 AND STRONTIUM-90 IN MAN. Raymond T. Moore (Public Health Service, Dallas, Tex.) and Donald R. Chadwick. Southern Med. J., 57: 66-8 (Jan. 1964).

Results of the U. S. Public Health Service program for surveying the levels of fallout radionuclides in milk are presented. In 1957, a Milk Sampling Network was established to sample milk from five milksheds. This network was expanded to 12 stations by 1959, and it is now composed of more than 60 stations set up to measure the radioactivity content of milk consumed by ~60 million Americans. Milk samples are analyzed quantitatively at the Division of Radiological Health Regional Laboratories in Winchester (Mass.), Montgomery (Ala.), and Las Vegas (Nev.) for those nuclides of largest potential health importance, including ^{131}I, ^{137}Cs, ^{140}Ba, ^{89}Sr, and ^{90}Sr. Data on contributions of various sources of intake of ^{90}Sr suggest that milk can serve as a useful indicator of the levels of total daily intake of this element. Data support the conclusion that fresh milk was the only significant source of radiation exposure to the thyroid gland of the population during the period of Soviet tests in the fall of 1961. Results of the ^{131}I analysis from the Milk Sampling Network for the 12 months, September 1, 1961, to August 31, 1962, are tabulated. The thyroid dose was then calculated on the basis of an annual average daily intake of 80 $\mu\mu$C of ^{131}I resulting in a dose of 500 millirem/yr to infants in which the thyroid wt is 2 g. The average annual dose to the thyroid from radioiodine for the 12 months, September 1, 1961, through August 31, 1962, was thus calculated to be 220 millirem. (BBB)

18111 PUBLIC HEALTH PROBLEMS IN CIVIL DEFENSE. C. A. Pigford (Houston City Health Dept., Tex.). Texas State J. Med., 58: 652-3(Aug. 1962).

The role played by municipal health departments in civil defense is dealt with, with emphasis on maintenance of a water supply should there be a thermonuclear attack. Measures to be taken against biological and chemical warfare agents which may represent a serious hazard to emergency water supplies are also discussed. (BBB)

18112 THE PROBLEM OF RADIATION HAZARD AND RADIATION PROTECTION. J. Zakovsky (Phys.-Techn. Pruefanstalt fuer Radiologie und Elektromedizin, Vienna). Wien. Med. Wochschr., 111: 601-4(Sept. 16, 1961). (In German)

X-ray studies of the thoracic region amount to 30% of all diagnostic x-ray studies and hence may contribute to genetic effects of radiation injury. Quantitative evaluation of radiation injury depends on the calculated skin dose received, and on the dose to the gonads from scattered radiation. The radiation burden imposed on the gonads in males is ~2.5 mr/r skin dose. This is ~10 times as great as in female patients. The dose can be reduced considerably by Pb shielding, but in practice these protective procedures are not simple to perform. The gonadal radiation received from a thoracic x-ray study is ~ equivalent to the total background radiation normally received within a year. Bone marrow damage may also result from thoracic radiation, and some incidence of leukemia has been attributed to this cause. In order to reduce the possibility of radiation injuries from scattered radiation the focus-skin distance should never be less than 30 cm, and should be more than 45 cm, if possible. The radiation exposure period should be accurately timed and the amperage should not exceed 3 ma. The size of the radiation field should be kept as small as possible, and the sensitivity of the optical system and film should be as great as possible. Special precautions should be taken with children and pregnant women. Views should be taken only after the sixth gestational month, and after serious consideration. Children under 14 should be excluded from x-ray studies if possible. Protective clothing should have a Pb equivalent of at least 0.2 mm. The radiation doses received by personnel should be checked constantly by means of ionization chambers and film badges in order to ensure that the protective measures employed really keep radiation exposure down to within the permissible values. (BBB)

18113 ZASHCHITNOE OBORUDOVANIE SREDSTVA INDIVIDYUAL'NOI ZASHCHITY I ZASHCHITNYE MATERIALY DLYA RABOTY S RADIOAKTIVNYMI VESHCHESTVAMI PREDLOGAGAEMYE K REALIZATSII V 1964g. INFORMATSIONNYI SPRAVAVOCHNIKH. (Remote Control Equipment Clothing for Individual Protection and Sanitation Equipment for Handling Radioactive Materials Suggested for 1964. Moscow, Gosatomizdat, 1963. 84p.

Laboratory furniture, remote-control equipment, shielding, containers, waste disposal, transportation, structural material, and instrumentation for radioactive materials are described. Filters, filtration techniques, sanitation devices, and protective clothing for personnel protection are discussed. (R.V.J.)

18114 RADIOLOGICAL HEALTH AND SAFETY IN MINING AND MILLING OF NUCLEAR MATERIALS. VOL. I. Proceedings of the Symposium Held in Vienna, 26-31 August 1963. (International Atomic Energy Agency, Vienna). Proceedings Series. Jan. 1964. 482p. (STI/PUB/78(Vol.I)). $10.00; Sch 210.-; 60s.stg; F.fr. 40.-; DM 35.-(IAEA).

Thirty-five papers were presented, and separate abstracts were prepared for 14. Abstracts of the remaining papers appeared in NSA as 17: 32310, 40510, 40511, 40512, 40513, 40658, 41023, 41139, 41141, 41145, 41148, 41149, 41150, 41151, 41152, 41153, 41159, 41161, 41162, 41172, and 18: 16240. (H.M.G.)

For abstracts of individual papers see: 18115, 18116, 18117, 18118, 18119, 18120, 18121, 18122, 18123, 18124, 18125, 18126, 18127, and 18128.

18115 INTRODUCTORY REMARKS CONCERNING HEALTH AND SAFETY IN URANIUM MINES. A. Schraub (Universitat, Giessen, Ger.). p.3-8 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. I." Vienna, International Atomic Energy Agency, 1964.

The historical development of the problems concerning health and safety in U mines is briefly reported. Efforts of different scientists engaged in the solution of these problems, and contributions of the team from the Federal Republic of Germany are described. (auth)

18116 ENVIRONMENTAL STUDIES IN THE URANIUM MINES. D. A. Holaday and H. N. Doyle (Public Health Service, Salt Lake City). p.9-20 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. I." Vienna, International Atomic Energy Agency, 1964.

A long-range study underway by the Public Health Service since 1950 seeks to define the effect of uranium-mining operations on the health of the miners and to derive data leading to the establishment of a healthful working environment. The environmental study is designed: to measure the atmospheric concentration of Rn and daughters and to obtain exposure data on the miners included in the medical study. Uranium mines in the U. S. A. vary widely in size, ranging from two-man operations to those employing several hundred men. Environmental radiation measurements were collected from over 800 mines, and these were used to evaluate the exposure of the miners and to assist in control procedures. Since 1950, there has been a marked decrease in the Rn-daughter concentrations; however, in many cases, the exposures are at present above the recommended levels. Continued efforts are being made to reduce the exposure of the miners to radiation. These efforts involve close co-operation with the state Health and Mining Departments, training courses for official agency and mining personnel, and continued surveillance and inspection. The Rn-daughter concentrations in the uranium mines for the past 12 yr are traced, and those techniques which have been effective in reducing the concentrations are discussed. At the start of the study, no standards were available which could be applied to U mines. Through conferences with all co-operating agencies, a working level of 1.3×10^5 Mev of potential α energy/l of air of Rn-daughter products was suggested as a standard. Uranium mines do not come under the jurisdiction of the Atomic Energy Commission but are subject to inspection or regulation by several other agencies. The states in which the mines are located have primary responsibility for establishing health and safety rules. A chaotic situation has been avoided by an agreement of all state agencies to use the American Standards Association Standard for Uranium Mines and Mills as a guide for their inspection and regulatory activities. This stand sets forth detailed recommendations on the management of radiation exposures in mines and, specifically, the methods of air sampling and analysis. Thus, results obtained by different groups are comparable and mine operators are not confronted with widely different standards in the various U-mining areas. (auth)

18117 EPIDEMIOLOGICAL STUDIES OF SOME NON-FATAL EFFECTS OF URANIUM MINING. V. E. Archer, B. E. Carrol, H. P. Brinton, and G. Saccomanno (Public Health Service, Salt Lake City). p. 21-36 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. I." Vienna, International Atomic Energy Agency, 1964.

Voluntary medical examinations of U miners in the Colorado Plateau of the U. S. A. were begun in 1950 and have continued at regularly scheduled intervals. Since 1954 an attempt has been made to examine all men working in the U mining industry. Participation has varied from 70 to 90% of the employed miners. Since the mines are widely spaced through very rugged terrain in a sparsely populated area, it was necessary to organize self-sustaining mobile examining teams. Between 1950 and 1960, 6929 examinations were performed, of these, about 1500 were repeat examinations. In addition to the usual components of a medical examination, many special clinical tests were included. An analysis of part of the medical examination data was accomplished. Increased rates of emphysema, shortness of breath, persistent cough, pulmonary fibrosis, and cell changes in sputum suggestive of radiation effect, are associated with increasing radiation exposures in U mines. Other factors, such as cigarette smoking, age, and altitude, which may have similar associations, are adjusted for, or considered separately. (auth)

18118 SOME UNSOLVED PROBLEMS IN URANIUM MINING. D. A. Holaday (Public Health Service, Salt Lake City). p.51-7 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. I." Vienna, International Atomic Energy Agency, 1964.

A long-term epidemiologic study is underway in the U. S. mines and a mass of environmental data has been accumulated. Additional studies have developed relations between ventilation rates, Rn emanation rates, and atmospheric concentrations of Rn and Rn daughters. On the basis of present knowledge, control procedures were instituted, however, many research needs are yet unmet. Except for the production of lung cancer, little is known about other biologic effects. Estimates of the radiation exposure of the miners are based on incomplete environmental measurements, and evidence is available that the present methods of evaluating the environment may not reflect the actual radiation hazard. Needed research is identified. (auth)

18119 THE CONTROL OF RADIATION HAZARDS IN CANADIAN URANIUM MINES AND MILLS WITH SPECIFIC REFERENCES TO THE BEAVERLODGE OPERATION OF ELDORADO MINING AND REFINING LTD. C. F. Smith (Eldorado Mining and Refining Ltd., Eldorado, Saskatchewan, Can.). p.67-82 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. I." Vienna, International Atomic Energy Agency, 1964.

The health hazards associated with the mining and milling of U have been a matter of serious concern to government and mine-operating personnel since the beginning of the industry. Early investigations indicated that internal radiation was the major problem. Miners were exposed to Rn and its decay products in mine atmospheres as a result of opening up ore bodies containing Ra. Although inhalation of U by miners was not a problem, it was found that mill personnel working on the U precipitate excreted significant

amounts of U in their urines. Practical field methods of measuring radiation levels were developed to assess the problem and guide the operators in implementing effective controls. Adequate ventilation, efficiently distributed to all mine working areas, and the control of dust were necessary to reduce the hazard of Rn and its daughters to safe limits. In precipitate handling, measures were taken to reduce the exposure to airborne U in working atmospheres by dust control and ventilation. To reduce the possibility of ingestion, operating personnel were trained in the necessary precautions of personal hygiene. The provision for adequate ventilation, maintenance and control is an important economic aspect to the mine operator. This involves increased development for intake and exhaust airways, capital charges for large volume fans, and heating equipment, and operating charges for power, heating, distribution, and engineering. The experience of a Canadian U mine in controlling the hazard of internal radiation is dealt with, and the practicability and economics of using ventilation to control radiation is discussed. (auth)

18120 ORGANIZATION IN THE URANIUM MINE OF SHINKOLOBWE AT KATANGA, CONGO REPUBLIC. H. Otenga (Ministère du Travail et de la Prévoyance Sociale, Leopoldville, Congo Republic), J. Roels, and L. Drexler. p.151-9 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. I." Vienna, International Atomic Energy Agency, 1964. (In French)

Uranium in Katanga (Congo Republic) is concentrated in a single mine. The mine of Shinkolobwe, discovered in 1915, has been exploited for radium since 1922. During this period it was an open-cut mine. Uranium extraction commenced at Shinkolobwe only after the second world war. The mine was then transformed into an underground mine. From the beginning of its exploitation the workers were observed very closely by a medical service equipped with all modern techniques. A series of precautions (changes of shift work, ventilation, and medical observation) were taken even before the establishment of international standards. With regard to the actual techniques of radiation detection and radiological protection, these were adopted since they were established. A regular control of radioactive dust, Rn, and its daughter products in the air and in water were carried out. Blood tests and radiological control were obligatory for all workers. A film-badge service functioned since 1947. The indication of absorbed doses were displayed by a system of individual badges. The mine has been closed since April, 1960. (auth)

18121 OPERATIONAL EXPERIENCE IN THE HEALTH PHYSICS MANAGEMENT OF THORIUM INDUSTRY IN INDIA. S. V. Murthy and P. P. V. J. Nambiar (Atomic Energy Establishment, Trombay, India). p.169-201 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. I." Vienna, International Atomic Energy Agency, 1964.

Monazite, occurring as a constituent of the beach sands of Kerala and Madras States in India, contains about 9% ThO_2 and 0.35% U_3O_8. Recovery of Th as Th nitrate from the ore is carried out in three stages. Health physics surveys of these unit processes were carried out, and the safety standards adopted were based on ICRP recommendations. Data on external exposure and internal contamination evaluation carried out largely by urinalysis is presented. Results obtained through five years of experience in operational safety in Th mineral processing are discussed. (auth)

18122 THE HAZARDS OF INHALING RADON-222 AND ITS SHORT-LIVED DAUGHTERS: CONSIDERATION OF PROPOSED MAXIMUM PERMISSIBLE CONCENTRATIONS IN AIR. C. G. Stewart and S. D. Simpson (Atomic Energy of Canada Ltd., Chalk River, Ont.). p.333-57 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. I." Vienna, International Atomic Energy Agency, 1964.

The following subject matters are discussed: a historical review of the recognition and definition of the absolute and relative hazard associated with the inhalation of ^{222}Rn, and its various short-lived daughters; a historical review of $(MPC)_a$ values that have been proposed for ^{222}Rn; the derivation of the present recommendation of Committee II of the International Commission on Radiological Protection for the $(MPC)_a$ of ^{222}Rn and its short-lived daughters; a review of the bases on which an $(MPC)_a$ value for ^{222}Rn, and its short-lived daughters may be predicted, including a discussion of the relation between absorbed radiation dose to the respiratory tract and the incidence of carcinoma of the lung; a discussion of the relation between the concentration of ^{222}Rn and its short-lived daughters in an atmosphere inhaled, and absorbed dose to the respiratory tract; a discussion of possible effects of bronchial ciliary action on the radiation dose calculated to be received by bronchial mucosa exposed to an atmosphere containing ^{222}Rn and its short-lived daughters; a discussion of the $(MPC)_a$ at present recommended by the Committee II of the International Commission on Radiological Protection in terms of the kind of information that is yet required, and on which a recommendation could be ideally based. (auth)

18123 DETERMINATION OF MAXIMUM PERMISSIBLE AIR CONCENTRATIONS OF Tn^{220} AND Rn^{222}. G. Walinder (Aktiebolaget Atomenergi, Stockholm). p.361-70 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. I." Vienna, International Atomic Energy Agency, 1964.

Some of the experimental and theoretical foundations which are quoted in connection with the determination of MPC levels of ^{220}Tn and ^{222}Rn are discussed. The concentration of dust, the size distribution of the airborne particles, and the half lives of the daughter nuclides are of vital importance for the distribution of the active deposit in different parts of the respiratory system and thus for the magnitude of the dose delivered. The adoption of the calculation models to the composition of the aerosols, which appears at different types of minings, may therefore have a marked influence on the determination of the MPC values. Of course, the ventilation conditions also play an important role when estimating the risks involved. On basis of the facts indicated above, and some general viewpoints which might be relevant to the problem, the serious consequences, not the least from consideration of health, of a stereotyped MPC fixation is discussed. (auth)

18124 PROBLEMS CONNECTED WITH THE PRACTICAL APPLICATION OF HEALTH REGULATIONS IN URANIUM MINES. H. Jammet (CEN, Fontenay-aux-Roses, France), D. Mechali, and J. Lafuma. p.387-90 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. I." Vienna, International Atomic Energy Agency, 1964. (In French)

The problems resulting from the application of health regulations in U mines are discussed. In these mines, the hazards can be classified as radioactive dust with a long lifetime, radon, and external irradiation. (auth)

18125 RADON MEASUREMENT AND DOSE IN URANIUM MINES. F. Billard, J. Miribel, G. Madeleine, and J. Pradel (CEN, Fontenay-aux-Roses, France). p.411-23 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. I." Vienna, International Atomic Energy Agency, 1964. (In French)

The noxiousness of Rn in U mines depends on its equilibrium with its daughter products. In France, Rn concentration is measured; in the United States the total disintegration energy of the active deposit is measured. The two methods are described, and their respective advantages and disadvantages explained. Comparative results are given for the French mines. (auth)

18126 LONG-LIVED RADIOACTIVE DUST MEASUREMENTS. A. Couix and J. Pradel (CEN, Fontenay-aux-Roses, France). p.425-31 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. I." Vienna, International Atomic Energy Agency, 1964. (In French)

The radioactive dust in suspension in the air in U mines has a long half life and must be monitored in the various workings. Samples are taken by means of equipment that has a compressed air pump worked from the main air supply or from bottles of compressed air at a pressure of 200 kg. The measurements are made by α counting with a ZnS scintillation counter. The method is compared with U monitoring by fluorimetry. (auth)

18127 A PRACTICAL METHOD FOR SYSTEMATICALLY EVALUATING THE RADIOACTIVITY IN THE AIR OF MINE GALLERIES. P. Pellerin, Y. Arnaud, and J. P. Moroni (CEN, Fontenay-aux-Roses, France). p.447-57 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. I." Vienna, International Atomic Energy Agency, 1964. (In French)

It is established that the radioactivity of the atmosphere of galleries depends essentially on ^{222}Rn and its daughter products. The method described is extremely sensitive. It consists of measuring immediately the activity of the active deposit of the daughter products of ^{222}Rn, fixed on solid or liquid aerosols in suspension in the atmosphere of the galleries. The method allows rapid checking, extending to numerous points. Samples are taken in series by suction on fixed filters which are then rapidly centralized. The threshold sensitivity of the counts made on standard scalers is in the order of 100 pC/m^3 air (one thousandth of the MPC for workers, or the order of magnitude of the natural radioactivity of the free atmosphere at ground level). The agreement with the reference method (samples taken in scintillation globes and counted on a photomultiplier) is good. It is found that, in an atmosphere charged with dust, the radioactivity of the natural gases is low compared with that of the suspensions which fix their daughter products, and the confinement of this environment allows these solid deposits to attain their radioactive equilibrium. Moreover, as atmospheric radioactive suspensions are a vital factor in internal contamination, the technique of limiting sampling to the suspensions gives results that are very representative of the real hazard; because of this, and its rapidity, sensitivity, and the ease with which it can be carried out on a routine basis, it is a good method of supervising the work environment. (auth)

18128 EVALUATING METHOD FOR AIRBORNE RADON DAUGHTERS. (EXPERIMENTAL STUDY ON THE VARIETY OF RADON-DAUGHTER COLLECTING EFFICIENCIES OF SEVERAL FILTER MEDIA UNDER VARIOUS CONDITIONS OF MAKE-UP TEST AIR). T. Inouye, Y. Yamada, and S. Watanabe (Musashi Inst. of Tech., Kawasaki City, Japan). p.459-70 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. I." Vienna, International Atomic Energy Agency, 1964.

The sampling method with filter media, scaling of α and β disintegrations on the filter media and calculating of initial atom numbers of α and β emitters on the filter media from scaling data is a common evaluating one for short-lived airborne Rn daughters. The collecting efficiencies of filter media vary with various factors connected with sampling air, such as sampling rate, humidity, special quality and particle-size distribution of Rn daughters and other aerosols. Various conditions of test air in a closed test-air circulation system were created and tested collecting efficiencies of several filter media under various sampling rates and duration in each case of abovementioned conditions of air. Useful information was obtained about the variations of the Rn-daughter collecting efficiencies of several filter media under various conditions of sampling air. (auth)

18129 RADIATION SAFETY MANUAL. San Diego, Calif., General Dynamics/Convair, [1964]. 24p.

Procedures are outlined for the safe handling and control of radiation-emitting materials and equipment. The instructions are based on current technical standards and recommendations of the California Bureau of Radiological Health, California Division of Industrial Safety, Atomic Energy Commission, and the National Bureau of Standards Handbooks. (C.H.)

18130 APPARATUS FOR STORING, HANDLING AND/OR UTILIZING HIGHLY RADIOACTIVE MATERIALS. Robert Bernas. U. S. Patent 3,127,515. Mar. 31, 1964. Priority date Dec. 30, 1958, France.

An apparatus comprising a protective mass with a recess or cavity for storing a radiation source is designed with means for positively indicating when the source is actually in its protected position. The means is a radiation detector, preferably of the radioresistive type, which is near the protective position and has a predetermined sensitivity so that it will yield positive indication only when the source is located exactly in its protected position. The sensitivity may be adjusted by means of filters. Several embodiments of the apparatus are described. (D.L.C.)

18131 IRRADIATION DOSE RATE MEASUREMENT. Volfgang Dittssh and Kristian Leber. Russian Patent 158,028.

A method for measuring an irradiation dose based on the modulation of the measured flux is described. To increase the accuracy of measurement at both low- and high-dose rates, the measured flux is modulated by a control source, amplified at the output of a scintillation counter, discriminated, and then applied to an integrator. The dose is determined through the constant component of the voltage separated at the integrator output. To compare it with the reference voltage, the alternating component is applied to the phase detector, and the resulting error signal is used to control the charge of the integrator capacitor. (OTS)

INSTRUMENTATION

General

Refer also to abstract 18792.

18132 (CEA-Bib-34) LES THERMOCOUPLES. (Thermocouples). J. Dirian (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1963. 81p.

The annotated bibliography deals with theoretical and technological studies on thermocouples from 1955 to March 1963. Thermocouples in reactors are included. (276 references.) (auth)

18133 (JINR-P-1554) REZONATOR DLYA NABLYUDENIYA EPR V DETSIMETROVOM DIAPAZONE. (A Resonator Observing Electronic Paramagnetic Resonance in a Decimetric Range). Yu. N. Denisov and V. V. Kalinichenko (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 7p.

The use of a quarter-wave coaxial resonator with a spiral internal conductor to observe electron paramagnetic resonance in the decimeter wave length range is proposed. It is shown that the intensity of the electronic paramagnetic resonance signal for such a resonator is ten times greater than for the usual coaxial resonator. (auth)

18134 (NASA-CR-26) HIGH-TEMPERATURE, THIN-FILM RESISTANCE THERMOMETERS FOR HEAT TRANSFER MEASUREMENT. Leonard Bogdan (Cornell Aeronautical Lab., Inc., Buffalo). Apr. 1964. Contract NAS 8-823. 24p.

Development of a high-temperature, thin-film resistance thermometer for heat transfer measurements is described. This heat transfer gage, comprising a thin, platinum-alloy film deposited on a pyrex substrate, is operable at sustained steady-state temperatures to 1000°F. Details of the calibration procedures employed to evaluate the thermal and electrical characteristics of the gage are described. The calibration data are presented and compared with other published data in the temperature range where direct comparison is possible. (auth)

18135 (NP-13750) DEVELOPMENT OF ELECTRICAL SWITCHGEAR FOR SPACE NUCLEAR ELECTRICAL SYSTEMS. Quarterly Progress Report No. 2, October 16, 1963–January 16, 1964. R. N. Edwards, ed. (General Electric Co. Spacecraft Dept., Cincinnati). Contract NAS 3-2546. 26p.

The d-c engine contactor was reviewed to gain a better appreciation of its requirements. It was concluded that its present specifications and its chopping approach are compatible with intended application. It was further concluded that the ion engine would require some form of current limiting and that voltage surges caused by ion engine and contactor chops would probably require voltage surge suppressors in ultimate applications. The a-c interruption test facility was set-up and checked out with a conventional vacuum interrupter in normal environment. The capacitor discharge 3000 cycle ringing approach worked very well. The conventional vacuum interrupter showed no degradation of capability at 2000 cycles as compared to its 60 cycle performance. It easily interrupted 1800 to 2900 amperes peak with recovery voltages up to 4000 volts and recovery frequencies from 167 kc to 480 kc. These frequencies are considerably higher than might be expected in an actual system. The materials test facility design was completed. (auth)

18136 (NYO-2910-2) APPLICATIONS OF ULTRASONIC ENERGY: ULTRASONIC INSTRUMENTATION FOR NUCLEAR APPLICATIONS. BiMonthly Progress Report No. 14, December 1, 1963–January 31, 1964. (Aeroprojects, Inc., West Chester, Penna.). Feb. 1964. Contract AT(30-1)-2910. 11p.

Work on a molten salt level detector for MSRE was initiated. Design of the proposed unit was started. Improvements in the experimental set-up for acoustical thermometry have resulted in greatly improved reproducibility and precision of measurement. (auth)

18137 (ORINS-44) RADIOASSAY OF THIN-LAYER CHROMATOGRAMS: BLUEPRINTS FOR ZONAL SCRAPER. Fred Snyder, T. J. Alford, and Harry Kimble (Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.). Contract AT(40-1)-GEN-33. 12p.

This will be CAPE-1122.

A scraping device was designed for the rapid and quantitative transfer of extremely small zones of adsorbent from narrow glass plates into counting vials. The device consists of a spring-loaded fixed single-edge replaceable razor blade mounted so that the glass plate can be moved along a guide edge while the absorbent falls into the vial. (D.L.C.)

18138 (RTD-TDR-63-4015) A PROBE FOR THE INSTANTANEOUS MEASUREMENT OF SURFACE TEMPERATURE. Gerald A. Sterbutzel, John R. Shoemaker, Robert C. MacArthur, Henry M. Korytkowski, Franklin A. Vassallo, and W. R. Brown (Cornell Aeronautical Lab., Inc., Buffalo). July 1963. Contract AF33(657)-8745. 92p.

A description is given of the design, development, and evaluation of a probe system with which instantaneous temperatures can be measured on a variety of surfaces heated by radiation. A 1000°F system, its methods of operation, and its performance characteristics are discussed. It is shown that the 1000°F probe operates on a variety of materials with an accuracy generally better than $\frac{3}{8}$ percent and with a time constant of the order of 0.1 seconds. A comparison of the performance of permanent surface thermocouple installations using iron-constantan, chromel-constantan, and chromel-alumel thermocouples, various thermocouple wire sizes, orientations, rates of heating, and surface materials was made with the 1000°F probe performance. In almost every case, the accuracy of the probe was better than the accuracy of permanent surface thermocouple installation. The design of a probe system believed to be feasible for extending the range of operation to 3000°F is presented. Detailed information is also given on the development of the sensor, fabrication of a probe, and a discussion of thermocouple attachment methods to non-metallic surfaces. (auth)

18139 (ZFK-PHA-3) DER EINFLUSS DER IMPULSDICHTE AUF DIE VERSTÄRKUNG VON FOTOVERVIELFACHERN. (The Influence of Pulse Density on the Behavior of Photomultipliers). H. Jungclaussen (Germany. Zentralinstitut für Kernphysik, Dresden). Mar. 1961. 11p.

Twenty-five photomultipliers were examined to test

their behavior when loaded with a high pulse density. The most suitable type showed a reduction of nearly 3% in pulse height when the pulse density changed from 2×10^3 to 10^5 pulses per second. (auth)

18140 (ZFK-PHA-10) NOTES ON THE EXISTENCE OF PREPULSES IN PHOTOMULTIPLIERS. Manfred Bonitz, Wolfgang Meiling, and Franz Stary (Germany. Zentralinstitut für Kernphysik, Dresden). Sept. 1963. 19p.

Photomultipliers, type 56 AVP, show prepulses which appear about 10 nanosecond ahead of the pulse. The focusing electrode F is considered as the most probable source of this prepulse condition. For the registration of prompt coincidence between the output pulse of a single photomultiplier and the electric pulse of a light-pulse generator, a multi-channel time analyzer is utilized. Prepulses tend to spread the coincidence curve with consequent asymmetric formation when the multiplier high-voltage level exceeds 2.2 kv. Due to prepulse occurrence resolving time is impaired, which is not mentioned, for instance, in the theoretical predictions of Gatti and Svelto, and seriously hampers the comparison of theory and experiment. This prepulse occurrence was also noted in Soviet multipliers, type Ф3Y-36. On the other hand, the new photomultiplier, K14FS50, constructed by VEB Carl Zeiss JENA, shows no evidence of this prepulsing. Its differently designed focusing system may be the reason. (auth)

18141 A NUCLEAR MAGNETIC RESONANCE MASER. Henri Benoit. Ann. Phys. (Paris), 4: 1439-83(1959). (In French)

A new type of two-level maser and a novel inversion technique for nuclear spins of a liquid in motion were developed. A high-frequency excitation in an inhomogeneous magnetic field was used, thus obtaining "fast adiabatic transition" conditions. This adiabatic transition was studied theoretically and experimentally. The agreement between theoretical predictions and experimental results was satisfactory and permitted convenient measurement of the relaxation time. A self-oscillator of the maser type was made to function at 30 MHz, in a director field of 7000 gauss, utilizing the water current thus activated. The same principle was used to make another self-oscillator of the Maser type in a 3.3 gauss field at 14 kHz frequency. This maser was studied in detail both theoretically and experimentally. It has the characteristics of obtaining a considerable macroscopic magnetic equilibrium, corresponding to a field of 3000 gauss, and a relatively short (less than 0.1 sec) transverse relaxation time. The corresponding overvoltage of the nuclear magnetic resonance is only 3800. Practical applications to the measurement and stabilization of the magnetic field, to nuclear magnetic resonance spectroscopy, and to the measurement of relaxation times were envisaged in detail. (tr-auth)

18142 A PRECISION SPECTROMETER FOR THE NUCLEAR RESONANCE OF LIQUIDS IN A WEAK FIELD. Jacques Hennequin. Ann. Phys. (Paris), 6: 949-99(1961). (In French)

A procedure was studied that remedied the lack of sensitivity of weak-field nuclear magnetic resonance spectrometers. It consists in exposing the sample to a high field which confers on it a nuclear magnetization several times higher than the equilibrium magnetization in the weak field where the resonance is detected. The use of a liquid for a sample requires that the prepolarization be done continuously. The electromagnet necessary for the preliminary polarization should disturb the director field as little as possible. A magnetic nuclear resonance maser was constructed using this very intense polarization in conjunction with the turning sample technique. The increase of the overvoltage in the oscillating circuit was suppressed by electronic reaction. High resolution spectra were obtained in fields from 1 gauss to less than 200 mgauss. Sodium hypophosphite in concentrated aqueous solution, the liquid studied, had an indirect interaction between the phosphorus and the hydrogen, characterized by a coupling constant J. In the field region examined, J is of the same order of magnitude as the difference of the resonance frequencies of the two elements. A similar phenomenon is found in strong fields when J is of the order of the chemical displacement. In both cases, the spectra have numerous rays whose positions and intensities vary with the field. The comparison of experimental results with theoretical predictions is much easier in weak fields as there is better resolution of the rays. The precision was limited only by the field fluctuations. (tr-auth)

18143 ERRORS DUE TO APPARATUS IN THE DETERMINATION OF THE INTENSITY OF OVERLAPPING SPECTRAL LINES. L. S. Gorn and B. I. Khazanov. At. Energ. (USSR), 16: 58-60(Jan. 1964). (In Russian)

If the energy resolution of the detectors is insufficient and two neighboring spectra lines tend to fuse together, the relative content of the emitter in the preparation may be determined by means of a differential method, involving measurements in 2 neighboring channels. This requires a much longer time period for carrying out the measurements and also results in the increase of the statistical error. Another source of error lies in the apparatus used; its drift affects the energy scale and the channel width. An analysis of this factor indicated that the error may reach several tens of per cent. It is especially large if a narrow channel width is used while measuring a weak line on a strong background. Thus, the error due to the apparatus is comparable to the systematic and statistical component of the error and must be taken into account. Formulas were derived for estimating the magnitude of the error. (TTT)

18144 A METHOD OF TESTING THE STABILITY OF PHOTOELECTRONIC MULTIPLIERS WITH TIME. Ts. Bonchev. Compt. Rend. Acad. Bulgare Sci., 16: 697-700 (1963).

A method for distinguishing between variations in the amplification of a photoelectronic multiplier and variations in the electronic apparatus used by means of a block diagram consisting of a photoelectronic multiplier with cathode follower at the input to two identical devices consisting of an amplifier, single-channel analyzer, and counter device is proposed. The results were analyzed by plotting the deviations from the average number of pulses for the two channels on a plane (delta-x and delta-y) and by constructing vectors with the components k_x, k_y, and /r/. (OTS)

18145 STUDY OF A THREE-DIMENSIONAL SEISMIC DETECTION SYSTEM. R. A. Broding (Seismograph Service Corp., Tulsa, Okla.), N. J. Bentley-Llewellyn, and D. P. Hearn. Geophysics, 29: 221-49(Apr. 1964).

As part of the VELA program for evaluating systems for detecting underground nuclear events, a three-dimensional seismic array was instrumented and operated for over a year. Three seismometers spaced 1,320 ft apart were clamped to casing in each of five abandoned oil wells and their outputs individually recorded on magnetic tape and conventional oscillograms. By time-shifting and compositing to achieve optimum signal coherence, signal-to-noise improvement factors somewhat greater than $\sqrt{n}$ times the ratio for a surface detector were obtained in the

signal spectrum from 4 to 10 cps, with lower improvement factors in the 1- to 4-c range. Studies of the nature of the site noise and its attenuation characteristics with depth are presented together with autocorrelation, power-spectrum, and coherence plots. To a depth of approximately 1,300 ft, the noise decay is exponential and characteristic of the fundamental Rayleigh mode. Below this depth the pattern is more complex and may be representative of higher mode Rayleigh and body waves. Expressions were derived for the theoretical comparison of the relative directional response of two- and three-dimensional arrays. (auth)

18146 MOTION PRODUCT SEISMOGRAMS. J. E. White (Marathon Oil Co., Littleton, Colo.). Geophysics, 29: 288-98(Apr. 1964).

A means of combining the voltages from a three-component seismometer so as to suppress noise waves arriving randomly from all directions and to indicate the direction of arrival of any particular wave-train, such as might be caused by an earthquake, explosion, or moving vehicle is described. Each of the horizontal components of motion is electronically multiplied by the vertical component, with or without phase shift, and the two resulting products are displayed as a vector pointing to the source of seismic waves. The equipment assembled to perform these operations is referred to as the Motion Product Detector. Mathematical analysis and small-scale tests of the Motion Product Detector on the Research Center grounds look promising. (auth)

18147 STATISTICS OF TIME IN PHOTOMULTIPLICATION. Raymond Euling. J. Appl. Phys., 35: 1391-1403 (May 1964).

Photomultiplication is considered as a branching process. The output current of the photomultiplier is studied as a function of the statistical distributions of photon emission, electron flight times, and secondary emission yields. Expressions are derived for the timing accuracy of photomultipliers and scintillation counters. (auth)

18148 A METHOD OF INCREASING THE PRODUCTION OF URANIUM IONS IN A MASS SPECTROMETER SOURCE. N. C. Fenner (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Sci. Instr., 41: 48-9(Jan. 1964).

The efficiency of a boat filament is increased by exposing the sample to a hot rhenium filament in an atmosphere of hydrogen and oxygen at about 0.3 torr. Gains of three orders of magnitude were attained with samples of 10^{-8} g of uranium loaded as uranyl nitrate. This treatment is compared with a benzene treated boat and a triple filament over a range of sample sizes, and an explanation of the results is given. (auth)

18149 SUPERCONDUCTORS IN INSTRUMENTATION. D. H. Parkinson (Royal Radar Establishment, Great Malvern, Worcs., Eng.). J. Sci. Instr., 41: 68-77(Feb. 1964).

During the last two decades the unique and unusual properties of superconductors have begun to be extensively exploited. Some of the applications, both suggested and actual, are reviewed. There are several which have lead to "instruments" in the broadest sense. The superconducting bolometer depending on the steep resistance-temperature characteristic in the transition is an example. Superconducting galvanometers of very high sensitivity have also been developed. The destruction of superconductivity by a magnetic field leads to a variety of switches which have zero resistance when "closed" and finite resistance when "open." The most well known is probably the cryotron which has received a great deal of attention with a view to computer applications. Switches of this type provide the basis of laboratory modulators and amplifiers which are capable of detecting extremely small voltages. However, the most significant development is the discovery that it is possible to generate powerful magnetic fields using solenoids built from hard worked superconductors, such as the niobium–zirconium alloys or the compound niobium–tin. Not only does this enable powerful fields to be available for laboratory use, but it makes possible the successful development of any solid state device depending on low temperatures and powerful magnetic fields. A new infrared detector is quoted as an example. The biggest obstruction to getting such devices widely used has been the lack of suitable small closed-circuit helium refrigerators, although these are now beginning to appear. (auth)

18150 PREPARATION OF ALPHA RAY SOURCE FOR RADIOACTIVE IONIZATION DETECTOR OF GAS-CHROMATOGRAPHY. Tsugio Takeuchi and Daido Ishii (Nagoya Univ., Japan). Kogyo Kagaku Zasshi, 66: 1295-8(Sept. 1963). (In Japanese)

Using ~100 μC of RaD in equilibrium with RaE and RaF, an α source for an ionization detector was manufactured for high-sensitivity gas chromatography. The preparation was made by electro-substitution and electro-deposition of the radioactive materials. RaF (Po) is liable to react with H evolved during the electrolysis and become H_2Po, which is volatile and very harmful for health. RaF was deposited on a Ag plate by electro-substitution and, RaD and RaE were then deposited on the same plate by internal electrolysis using Zn amalgam as the anode and without applying any outer potential. Good results in intensity of radiation, deposition state, safety, and stability were obtained with α sources prepared by this method. (from NSA of Japan)

18151 EXPERIENCE WITH THE OPERATION OF A RADIOACTIVE SNOW GAUGE AT LYSA HORA. J. Martinec (Water Utilization Research Inst., Prague). Meteorol. Zpravy, 16: 151-2(Oct. 1963).

A radioactive snow gauge was installed at the Lysa Hora station (1325 m above sea level) in order to overcome the difficulties of measuring the water content of the snow on the mountain. An evaluation was made of the first winter season with normal operation. The device is suitable for continuous measurements of deep snow packs. (OTS)

18152 FAST TRANSISTORIZED AMPLIFIER WITH LARGE DYNAMIC RANGE. A. Alberigi-Quaranta and M. Martini (Università, Bologna). Nucl. Instr. Methods, 25: 125-33(Dec. 1963).

The problem is discussed of building fast transistorized pulse amplifiers with a dynamic range of about 10 v. A prototype circuit is presented exhibiting the following characteristics: voltage gain 10; rise time max 4.5 nsec, min 2.5 nsec; max output pulse–12 v; input and output on coaxial cable; good frequency overloading and good stability against room temperature variations. (auth)

18153 OSCILLOGRAPHIC MEASUREMENT OF SHORT RESOLVING TIMES. J. Weber (Deutsches Elektronen Synchrotron, Hamburg). Nucl. Instr. Methods, 25: 285-7(Jan. 1964). (In German)

This paper presents a digital method of measuring the resolving time of coincidence circuits. To get a variable time distance between the testpulses, the feedbacks loops of two ring oscillators are made of slightly different lengths. From these oscillators the pulses are given separately on the coincidence being under test. At the output of that coincidence groups of pulses appear with a beat frequency. The enveloping shape of that group is the resolution function, which can directly be observed on the os-

cilloscope. With this method it is possible to follow the resolution curve in steps of less than 5×10^{-11} seconds. (auth)

18154 ELECTROMETER CIRCUIT DESIGN FOR EXTENDED BAND WIDTHS. W. K. Brookshier (Argonne National Lab., Ill.). Nucl. Instr. Methods, 25: 317-27 (Jan. 1964).

Linear and logarithmic electrometer circuits have been developed with band widths extended a factor of 10 or more beyond the usual limit. The method consists of reducing the stray capacitance across the feedback element by a nearly optimum shielding structure, and designing the amplifier with sufficient gain to degenerate the effects of input capacitance to ground. This method yields a very simple design approach for predicting the character of the transient response, and the response obtained is insignificantly affected by changes of ±20% in the value of any circuit element. Techniques for generating current step functions for testing such circuits are discussed. (auth)

18155 SINGLE-ELECTRON SPECTRA IN PHOTOMULTIPLIERS. C. F. G. Delaney and P. W. Walton (Univ. of Dublin). Nucl. Instr. Methods, 25: 353-6(Jan. 1964).

Single electron spectra for a number of photomultipliers of both venetian blind and box and grid type are reported. It is shown that if the contribution of electrons ejected directly by light incident on the first dynode is either eliminated or allowed for, then spectra resembling those predicted on the assumption of Poissonian statistics at each dynode are obtained in most cases. (auth)

18156 NEUTRON TRANSMUTATIONS DOPE SEMICONDUCTORS. Carl L. Klahr and Melvin S. Cohen (Fundamental Methods Associates, Inc., New York). Nucleonics, 22: No. 4, 62-5(Apr. 1964).

A process for making semiconductor junctions using neutron transmutation doping is described. Phosphorus, an n-type impurity, is formed in the reaction $^{30}Si + n \rightarrow {}^{31}Si$ which beta decays forming ^{31}P. (C.E.S.)

18157 AN INTERFEROMETER FOR ISOTOPE ANALYSIS. Yoshio Urano and Sadao Nakajima (Government Industrial Research Inst., Osaka). Osaka Kogyo Gijutsu Shikensho Kiho, 14: 260-5(July 1963). (In Japanese)

An interferometer for analyzing the isotopic composition of elements was constructed. The interferometer is composed of a scanning Fabry-Perot etalon and a photoelectric recording system. A device using a CdS cell and an electromagnet controls the pressure. Using this interferometer, the amount of Li-6 in a natural Li sample was determined to be 7.2 ± 0.5%. (from NSA of Japan)

18158 RECORDER RECENTERING CIRCUIT FOR MAGNETIC RESONANCE. D. R. Torgeson and W. A. Rhinehart (Ames Lab., Ames, Iowa). Rev. Sci. Instr., 34: 1447-8(Dec. 1963). (IS-720)

A recorder recentering circuit is shown for recentering the recorder pen automatically when the baseline drifts sufficiently to force the pen off the dynamic scale during steady-state magnetic resonance and nuclear quadrupole resonance experiments. (R.E.U.)

18159 TEMPERATURE MEASUREMENTS USING SMALL QUANTITIES OF CERIUM MAGNESIUM NITRATE. W. R. Abel, A. C. Anderson, and J. C. Wheatley (Univ. of Illinois, Urbana). Rev. Sci. Instr. 35: 444-9(Apr. 1964).

A study is made of the requirements of a mutual inductance system suitable for precise temperature measurements using about one gram of cerium magnesium nitrate. The mutual inductance is measured by a commercial version of the electronic bridge originally proposed by Pillinger, Jastram, and Daunt [Rev. Sci. Instr. 29, 159 (1958)]. A discussion of the effects of spurious magnetic materials, of nearby paramagnetic salts, and of the vacuum jacket is given. The linearity and stability of the electronic bridge, as well as the effects of external circuitry, are also discussed. Results are given for the properties of two coil sets with cerium magnesium nitrate thermometers used to test the stability of the bridge and the validity of expressions for mutual inductance. It may be concluded that if solid air can be kept away from the coils, the long term instabilities for a 1-g thermometer lead to errors of about $0.004°K^{-1}$ in 1/T. A comparison between ballistic and 17-cps bridge measurements down to 0.015°K showed that 1/T* as determined by the two methods was the same with an error of less than 0.1%. (auth)

18160 LOW FREQUENCY SUPERREGENERATIVE OSCILLATOR DESIGN FOR THE DETECTION OF BROAD-LINE NUCLEAR MAGNETIC RESONANCES. Albert Narath (Sandia Lab., Albuquerque, N. Mex.), W. J. O'Sullivan, W. A. Robinson, and W. W. Simmons. Rev. Sci. Instr., 35: 476-80(Apr. 1964).

Two superregenerative nuclear magnetic resonance detectors are described which have proved useful for the detection of broad resonances. These oscillators are capable of sensitive operation at radio frequencies as low as 2.5 Mc and quench frequencies ranging from about 50 kc near 3 Mc to 120 kc at 10 Mc. In the one case for which a comparison was made, the sensitivity of the superregenerative oscillator design was found to be comparable to that of a crossed-coil spectrometer operating under optimum conditions. (auth)

18161 DISTANCE DETECTOR MANOMETER FOR MEASUREMENT AND CONTROL OF LIQUID HELIUM TEMPERATURES IN MAGNETIC FIELDS. E. W. Hornung and G. E. Brodale (Univ. of California, Berkeley). Rev. Sci. Instr., 35: 499-502(Apr. 1964).

An accurate device for measuring and controlling the pressure of a liquid helium bath is described. The device makes use of distance detectors which sense the levels of mercury in a manometer and adjust heat to the helium bath to keep the pressure constant. The device, unlike those using resistors as a sensing element, gives highly accurate control in the presence of changing magnetic fields. The manometer is also useful for general pressure measurements, giving rapid, accurate, and easily read results. (auth)

18162 DESIGN OF A LOW INDUCTANCE CAPACITOR AND SWITCH ASSEMBLY. R. S. Dike and E. L. Kemp (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instr., 35: 516-17(Apr. 1964). (LADC-5629)

The mounting of an ignitron on a capacitor results in a large inductance owing to parasitic inductance in the connections. In order to reduce the inductance, the ignitron housing should be designed to minimize parasitic inductance of the output cable, and the capacitor should have a large diameter center electrode and a concentric ground return located as close in as possible. A capacitor and switch assembly is described which has a total inductance of 0.04 μh and will deliver over 1600 j in 0.75 μsec. The assembly has been used in coaxial plasma gun banks. (D.L.C.)

18163 EFFECT OF PHOTOCATHODE-TO-FIRST DYNODE VOLTAGE ON PHOTOMULTIPLIER NOISE

PULSES. P. W. Walton (Univ. of Dublin). Rev. Sci. Instr., 35: 518-19(Apr. 1964).

The experiments of Pagano, in which the noise count at a high discriminator setting was found to reach a minimum at a V_C/V_D ratio of approximate unity, were repeated. Two low-noise photomultipliers (EMI 9514A, a venetian blind type, and EMI 9524S, of box and grid structure) were studied under conditions where all single electron noise was counted. The results do not show a minimum in the noise vs V_C/V_D graph, but instead a steadily rising curve tending toward a plateau. For the 9514A tube, the curve can be explained by a combination of the Schottky effect and an increase of the number of electrons produced at the first dynode as V_C is increased. (D.L.C.)

18164 TRIGGERED LOW-VOLTAGE SOURCES FOR POSITIVE IONS. R. E. Honig, S. S. Glass, and J. R. Woolston (RCA Labs., Princeton, N. J.). p.209-16 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

For mass spectrography of solids and other applications, several pulsed low-voltage sources were developed that produce intense beams of positive ions with moderate energy distribution (about 200 v). A unidirectional trigger pulse (1 to 4 μsec, 35 kv) breaks down the narrow (<1 mm) gap between two electrodes of the solid to be studied. This is followed by a low-voltage discharge, about 10 to 200 μsec, which usually is maintained by separate means. Mass spectra, energy distribution, and discharge mechanism (including cathode field emission, sputtering, and ionization by electron impact) are discussed in detail. (auth)

18165 PRODUCTION AND MASS SPECTROMETRY OF MULTIATOMIC ION BEAMS WITH CHARGE-TO-MASS RATIO 0.1 COUL/KG TO 10^7 COUL/KG. Charles D. Hendricks and James J. Hogan (Univ. of Illinois, Urbana). p.249-54 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

Several spectrometers of the quadrupole type were constructed. The range of specific charge measurement covered by the instruments ranges from about 10^7 coulomb/kilogram (hydrogen ion) to 10^{-1} (charged macroscopic particles of several microns diameter). Beams of charged particles in this specific charge range were produced and studied by means of the quadrupole mass-spectrometers. Beam production methods, analysis, and electronic construction details of the spectrometers are given. (auth)

18166 MONOCULAR PERISCOPE STAGE (Engineering Materials). (E. I. du Pont de Nemours and Co., Aiken, S. C.). (CAPE-1099)

Designed to be used in metallography, the oval stage plate is fabricated of ½ in. stainless steel and has a long axis of 6⅝ in. and a short axis of 4⅝ in. It is attached to a shaft 10⅛ in. long that is mounted on a tripod 1¾ in. high. See CAPE-1019 (NSA 17: 35966) for description of cell and monocular periscope. (F.S.)

18167 IMPROVEMENTS IN OR RELATING TO TELEVISION CAMERAS. Donald Jackson (to Pye Ltd.). British Patent 953,053. Mar. 25, 1964. Filed Oct. 12, 1959.

A television camera for use under extreme temperature conditions or in a reactor, is designed in which controls or attachments can be remotely actuated by pneumatic means derived from a cooling gas which is circulated through the camera housing. (D.L.C.)

18168 ICE DETECTOR SYSTEM. (to United Control Corp.). British Patent 953,228. Mar. 25, 1964. Priority date Apr. 26, 1960, United States.

A radiation source-detector probe for determining whether conditions for ice formation exist is designed for use in aircraft and missiles. The probe has a surface on which ice can form, a beta ray source (e.g. ^{90}Sr) near the surface, and a detector spaced from the source so that rays from the source to the detector must pass closely over the surface. The probe may be used to turn on automatically de-icing equipment when ice is formed on the probe. Several embodiments are given of the probe and control circuits for the de-icing equipment. (D.L.C.)

18169 IMPROVEMENTS IN OR RELATING TO FLUORIMETERS. Marcel Gouyon and Andre Pascal (to Commissariat à l'Energie Atomique). British Patent 953,356. Mar. 25, 1964. Priority date Nov. 19, 1959, France.

A portable fluorimeter with low power consumption is designed for uranium prospection. The fluorimeter comprises a battery and a spark-gap discharger for firing a flashbulb to produce a luminous beam; a hollow opaque sphere provided with a first filter for passing only uv rays in the beam, an orifice diametrically opposite the first filter for receiving the sample to be examined, and a second filter for passing only fluorescent rays; a photomultiplier receiving the fluorescent rays; an integrator circuit; and a galvanometer for measuring the photomultiplier pulses. The power consumption of the fluorimeter is ~4 watts when operated normally, i.e., about once every 2 minutes. (D.L.C.)

18170 AEROSOL PARTICLE COUNTER. Frank R. Gustavson (to Royco Instrument, Inc.). U. S. Patent 3,127,505. Mar. 31, 1964. Filed Apr. 26, 1960.

An apparatus is designed for measuring the quantity and sizes of aerosol particles. The apparatus includes an optical system, a photomultiplier, an integrator circuit, a discriminating circuit, a counter, and a recorder. An air flow system is provided in which ambient air is first drawn through the apparatus and then a reversed filtered air flow is used to clean the apparatus. (D.L.C.)

Radiation Detection

Refer also to abstracts 17677, 18879, 19285, 19437, and 19438.

18171 (BNL-7871) COMPARISON OF RAPID DATA PROCESSING SYSTEMS. Paul V. C. Hough (Brookhaven National Lab., Upton, N. Y.). Sept. 21, 1962. Contract [AT(30-2)-Gen-16]. 10p.

A comparative discussion is presented of the bubble chamber data processing systems FSD, SMP, and PEPR. Pattern recognition and rerun of failed events (QUEST) are discussed. Tentative specifications are presented for the MSP system. (D.L.C.)

18172 (BNL-7896) REVISED OPTICAL CONSTANTS FOR THE BNL 20'' CHAMBER. E. L. Hart (Brookhaven National Lab., Upton, N. Y.). June 20, 1962. Contract [AT(30-2)-GEN-16]. 22p.

The chamber parameters necessary for the calculation of optical constants to be used in geometric reconstruction programs are presented, and the revised optical constants obtained for the TRED program are listed. The results that should be obtained using any reconstruction program with the 20-in. chamber are also included. (auth)

18173 (BNL-7897) FILM FORMAT AND FIDUCIAL MARKS OF THE 20" BUBBLE CHAMBER. E. L. Hart (Brookhaven National Lab., Upton, N. Y.). Dec. 31, 1962. Contract AT-30-2-GEN-16. 6p.

A description is given of the 20-in. bubble chamber film format. The film format consists of: chamber image;

Arabic picture number; binary data box; Arabic view number; and the Hough-Powell road fiducial marks. The fiducial marks and their relation to the chamber optical constants are discussed. The constants are based on the standard measuring fiducials a and d. (P.C.H.)

18174 (BRL-1230) CONSTRUCTION AND CALIBRATION OF AN ANTI-COMPTON SPECTROMETER. Joseph A. Muscari, Jr. (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Sept. 1963. 55p.

By suppressing the Compton response, the anti-Compton spectrometer emphasizes the photopeak without sacrificing resolution. The detector's response matrix was experimentally determined with five monoenergetic gamma sources. By interpolating between the known energies and extrapolating from the measured shapes, the response to gamma rays within the range 230 to 1460 kev was found. Applying the inverse response matrix to several line spectra unfolded the pulse-height spectra. The spectrometer is described, together with the determination of the response matrix. The spectrometer has a pulse-height resolution of 6.5 to 11% and a Compton suppression of 47 to 70%. (auth)

18175 (EUR-588.e) ANALYSIS AND DEVELOPMENT OF THE SERIES EXPANSION METHODS IN THRESHOLD DETECTOR ACTIVATION DATA HANDLING. G. Di Cola and A. Rota (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy and European Atomic Energy Community. European Scientific Data Processing Center, Ispra, Italy). 1964. 20p. (CONF-440-1)

From Symposium on Fast and Epithermal Neutron Spectra in Reactors, Harwell, Eng., Dec. 1963.

The orthonormal and polynomial methods for analyzing activation data were investigated and tested. The effect of the weighting function when the orthonormal methods are used was determined. A development permitting the use of detectors with quasi-linear-dependent cross sections is proposed. The series expansion coefficients are obtained through the Gauss method by solving a least square problem. Activation data were processed using different polynomial expansions. (D.C.W.)

18176 (NP-13716) VREMYA PAMYATI V ISKROVOI KAMERE S BOL'SHIM PROMEZHUTKOM-MEZHDI ELEKTRODAMI I STRUKTURNYI KHARAKTER ISKROVYKH TREKOV. (Memory Time in a Spark Chamber with a Broad Gap Between Electrodes and the Structural Nature of Spark Tracks). V. A. Lyubimov and F. A. Pavlovskii (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki and U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1963. 8p.

Studies of the memory time in a spark chamber with a broad gap between electrodes showed that inert-gas filled chambers have memory times of tens of microseconds. However, a small admixture of air, propane, or alcohol reduces the memory time. The structure of the spark was also analyzed. The discharge characteristics (the number of bunches) depend on the high-voltage delay. With increased delay the number of bunches is reduced. Postulations are made on the relation between discharge characteristics and particle ionizing ability. (tr-auth)

18177 (TID-20418) AN INVESTIGATION OF A HELIUM-3 SOLID-STATE FAST NEUTRON SPECTROMETER (thesis). Thomas Allyn Steele (Washington. Univ., Seattle). 1963. 57p.

A fast neutron spectrometer using the $He^3(n,p)$ reaction was developed. Silicon surface-barrier charged-particle detectors are used with He^3 in a sandwich arrangement. Sum-coincidence circuitry is used, together with a multichannel analyzer to obtain neutron spectra. The theoretical bases of the spectrometer are summarized, and the manufacture and performance of the Si detectors are discussed. The efficiency of the spectrometer was determined to be 3.6×10^{-6} at 2.5 Mev using coincidence. The estimated efficiency is 5×10^{-5}, indicating that not all the reaction products are detected. The spectrometer appears to be useful for measurements in fast fluxes above 10^5 nv. (D.C.W.)

18178 (TID-20439) THE STABILIZATION OF A GAMMA-RAY SCINTILLATION SPECTROMETER AGAINST ZERO AND GAIN DRIFTS. Robert A. Dudley and Remigius Scarpatetti (International Atomic Energy Agency, Vienna). [nd]. Work Performed under Contract IAEA/US. 11p.

The performance and principles of a system used to stabilize a scintillation spectrometer against gain and zero drifts of every origin are described. It appears possible to eliminate almost completely gain or zero drifts. Evidence that other drifts are inconsequential is also presented. (D.C.W.)

18179 (WCAP-2562) MINIATURE NEUTRON DETECTOR DEVELOPMENT. Quarterly Progress Report, October 1–December 31, 1963. J. Weisman, ed. (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Jan. 16, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-2827. 19p. (EURAEC-935)

The development of miniature neutron detectors has continued along two main lines: development of improved junction structures and fabrication procedures, and development of diode configuration for very high temperature operation. Diodes are studied using a scanning electron microscope. Bonding to platinum appears encouraging. Bonds to tungsten, with or without an intermediate layer of platinum, have not withstood thermal cycling. A test assembly for evaluation of diode counting properties was built and put into operation. It is planned to use this equipment for high temperature annealing studies after a suitable diode configuration is developed. (auth)

18180 (CEA-tr-X-542) RECOMBINAISON DES IONS DANS LES CHAMBRES D'IONISATION UTILISEES POUR DOSER LE RAYONNEMENT ISSU D'UN BETATRON. (Recombination of Ions in Ionization Chambers Used for Measurement of Radiation from a Betatron). J. Allewaert (Institut Interuniversitaire des Sciences Nucleaires, Brussels). Translated into French from IISN-127, 1961. 7p.

The fraction of ions involved in recombination in a cylindrical chamber was investigated experimentally and theoretically as a function of the dose/pulse (r) and the distance (d) between the electrodes. Smaller values of r and larger values of d were considered than were used in previous studies. (D.C.W.)

18181 A FAST-NEUTRON MONITOR ALLOWING SEPARATION OF THE γ-BACKGROUND. A. Diaconescu (Inst. of Atomic Physics, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 14: 889-94(1963). (In Rumanian)

The organic scintillators used for the detection of fast neutrons are efficient but also very sensitive toward γ radiation and therefore the γ flux, which accompanies the neutron flux of the reactor, must be eliminated before detection. Following a scheme proposed by F. D. Brooks

(Nuclear Instr. & Methods 4: 151-63(1959)), according to which the various radiations are separated on the basis of the decay time of the generated light pulse, an instrument was built for discriminating against the background radiation. The pulse from the dynode was integrated by a circuit with a time constant of 10 μsec which was much higher than the decay time of the light flux. The device was successfully used to distinguish the desired radiation. A potentiometer was used to adjust the system in such a way that only the neutron-generated pulses appeared on the screen. By using a stilbene crystal, neutrons from a Po–Be source and from a fast neutron source could be distinguished against the radiation from a ^{60}Co source. (TTT)

18182 A SIMPLE CHARGED PARTICLE IDENTIFICATION SYSTEM. Sven Hjorth (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 25: 131-42(1964).

A system that identifies charged particles by means of the Ex(dE/dx) method is described. The system incorporates an electronic network which multiplies the pulses from two detectors. The multiplication is performed in the cheap commercially available beam deflection tube. The accuracy of the multiplication is shown to be satisfactory for the identification of different particles from nuclear reactions and the performance of the system was tested with protons from the reaction $^{10}B(d,p)^{11}B$ at E_d = 0.8 Mev. 21 references. (auth)

18183 SURFACE-BARRIER TYPE SILICON DETECTORS FOR MEASURING NEUTRON AND FISSION FRAGMENT FLUXES. I. A. Baranov and N. M. Kazarinov. At. Energ. (USSR), 16: 60-4(Jan. 1964). (In Russian)

The radiation sensitivity of some of the characteristics of Au–Si detectors toward fast and thermal neutrons and fission fragments was investigated, in order to study the lattice defects generated in these detectors by scattering or by nuclear reactions. The experiments were carried out with n-type Si surface-barrier detectors having a resistance between 150 and 200 ohm cm. The pulse-amplitude spectra of the α particles of ^{241}Am and of the thermal-neutron-induced fission fragments of ^{235}U, the time of resolution of the detectors, the average lifetime of the charge carriers, or the recombination time of the electron-hole pair, and the n-p transition capacity of the detectors were determined before and after the irradiation. The 15-Mev neutrons were obtained by means of a $T(d,n)^4He$ low-voltage neutron generator. The results indicated that an increase of the neutron dose results in the decrease of the lifetime of the charge carriers while increasing the resistance of the Si. Tests with 3-Mev neutrons, obtained by the $D(d,n)He^3$ reaction showed that the detectors are more stable against thermal than against fast neutrons. After exposure to the fission fragment flux, no substantial changes were observed in the time constant. (TTT)

18184 THE FILM BADGE. MOST USED PERSONAL DOSIMETER. Arthur S. Dobish (Nuclear Chicago Corp.). Atomics, 17: 43-5(Mar.-Apr. 1964).

The performance and analysis of photographic film badges are discussed. The effects of the different types of radiation are shown in developed film samples. (R.E.U.)

18185 A β-RADIATION SOURCE OF PLASTICINE FOR THE IRRADIATION OF ARTICULATED SURFACES. M. Zaduban (Radiobiologischen Laboratorium SAW, Kosice, Czech.). Atompraxis, 10: 140-4(Mar. 1964). (In German)

To produce radioactive-labeled plasticine with good plastic properties two mixtures of the following compounds stood the test: bentonite or white colored clay (bolus alba), solution of the radioactive isotope in water, solution of gum arabic and vaseline. The results of some tests were satisfactory. Packed up in caoutchouc, the plasticines can be used like a closed radiation source. (auth)

18186 A SIMPLE ARRANGEMENT FOR THE DETECTION AND DOSIMETRY OF FAST NEUTRONS. W. F. Schmidt (Universität, Berlin). Atompraxis, 10: 157-8 (Mar. 1964). (In German)

A simple arrangement for the detection and dosimetry of fast neutrons is described. As detector an ionization-chamber filled with liquid cyclohexane is used. Cyclohexane has the advantage of having tissue-equivalence. The neutron source was of the Po–Be type. (auth)

18187 THE ESTIMATION OF LOW GAMMA ACTIVITIES BY MEANS OF THE THREE-DIMENSIONAL SCINTILLATION DETECTOR NAG 202. M. Zaduban (Safarik Univ., Kosice, Czechoslovakia). Cesk. Farm., 11: 322-4 (July 5, 1962). (In Czech)

Estimation of low gamma activities by a scintillation detector is described. Results are described with solutions or suspensions of ^{51}Cr, ^{60}Co, ^{131}I, and ^{198}Au. The measured volumes of fluids were 30 ml, contained in 50-ml beakers of inner diameter 40 mm. If means are taken to prevent contamination of the crystal and of the cavity covering it, it is possible to measure the activity of the substance directly in the beaker. It has advantages mainly in biological studies. For measurements the shape and weight of the beaker must be uniform. A difference of 1 g in the weight of the beaker, causes an error of 2.9%. (BBB)

18188 RECORDING INDIVIDUAL TRACKS OF LOW ENERGY α PARTICLES IN CELLULOSE NITRATE FILMS. Monique Debeauvais and Pierre Cüer (Centre de Recherches Nucléaires, Strasbourg). Compt. Rend., 258: 1777-8 (Feb. 10, 1964). (In French)

It was shown that it is possible to record individual particle tracks in cellulose nitrate. These tracks are visible to the optical microscope after exposure to a NaOH solution when the angle of incidence is between 90 and 35°. The recording efficiency is complete for the α particles when the energy ≤3 Mev. (tr-auth)

18189 A PORTABLE TRANSISTOR NEUTRON RADIOMETER OPERATING WITH CORONA COUNTERS. V. Khristov, D. Damyanov, and G. Romanov. Compt. Rend. Acad. Bulgare Sci., 16: 693-6(1963).

The use of corona proportional counters, with great amplitude and a wide counter plateau with boron and uranium as detectors, made it possible to construct a portable transistor radiometer for neutrons with a considerably simplified electronic scheme (small coefficients of amplification and ordinary high-voltage stabilization). The functioning of such a radiometer in powerful gamma fields was investigated. High stability and simplicity were exhibited. (OTS)

18190 RADIOISOTOPES USED IN PHARMACY. 4. INSTRUMENTS FOR THE MEASUREMENT OF IONIZING RADIATION. A SURVEY. Buchardt Bloch (Royal Veterinary and Agricultural Coll., Copenhagen). Dansk Tiddsskr. Farm., 36: 81-92(May 1962). (In Danish)

18191 THE IMPROVEMENT OF GAS-FLOW COUNTER CHARACTERISTICS. Munemaru Imai and Shuji Yamada (Hitachi, Ltd., Tokyo). Genshiryoku Kogyo, 9: No. 7, 41-5 (July 1963). (In Japanese)

Characteristics of Al–C-type and Higinbotham-type amplifiers for gas-flow counters were examined. The overload characteristics of the Higinbotham-type amplifier with a delay line were found to be best. Plateau characteristics were investigated using the 2 amplifiers and pulse-height analysis. Radiation sources used were RaD + E, ^{234}Pb,

^{210}Bi, and ^{14}C. The Higinbotham type gave good results. The counting loss of the proportional counter under various amplifier gain at high counting rate was investigated. Current characteristics against overvoltage were also determined. Relations between the plateau characteristics and the structure of the counter head, amplifier, overvoltage characteristics, and counting loss of the proportional counter at high counting rate were pointed out. An improved counter head is described, in which an anode cylinder is put in a cathode cylinder with variable inside diameter. A center loop is at an end of the anode cylinder and can be shifted vertically or replaced by spares of various diameters. (from NSA of Japan)

18192 SEMICONDUCTOR SPECTROMETER FOR CHARGED PARTICLES. V. Yu. Gonchar, I. I. Zalyubovskii, L. A. Zubritskii, Yu. I. Titov, and G. P. Chursin (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR and Khar'kov State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 102-4(Jan. 1964). (In Russian)

The design is given of a spectrometer using semiconductor detectors of n-type silicon. Detector performance was checked using the 5.3-Mev α particles from ^{210}Po. The α spectrum from ^{27}Al(d,α)^{25}Mg (θ = 90°, E_d = 1.4 Mev) was measured. The spectrometer is capable of handling α spectra with energies to 7 Mev with a resolving power of 1.9%. (R.V.J.)

18193 SURFACE-BARRIER COUNTERS WITH PROTECTIVE ELECTRODES. L. A. Zubritskii, G. P. Chursin, V. Yu. Gonchar, and I. I. Zalyubovskii (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR and Khar'kov State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 105-6 (Jan. 1964). (In Russian)

The design is given of a simple surface-barrier counter using silicon and germanium detectors and equipped with an auxiliary electrode. Located at a short distance from the main electrode, the auxiliary prevents current leakage and extracts current carriers generated by photons in the interval between the main and auxiliary electrodes. With metallic electrodes of 0.1 μ thickness, the counter is insensitive to light. The resolving power of 100-mm^2 detectors was 5% for 5.3-Mev ^{210}Po α particles. (R.V.J.)

18194 WILSON CHAMBER FOR SPECIAL TRAINING IN A PHYSICS TEACHER'S COLLEGE. A. N. Solov'ev (Cherkask Teacher's Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 6, 58-61(1963). (In Russian)

The design is given of an automatic Wilson chamber for educational use. (R.V.J.)

18195 BUBBLE CHAMBER PHOTOGRAPHY. W. T. Welford (Imperial Coll. of Science and Tech., London). J. Phot. Sci., 10: 243-51(1962).

Optimal conditions for bubble chamber photography are described, the characteristics of a suitable emulsion are derived, and methods of testing emulsions for these characteristics are discussed. Technical aspects for the design and operation of bubble chambers, which have to be taken account of if good photographs suitable for accurate measurement are to be obtained, are enumerated. It is necessary to photograph the bubbles by darkground illumination, and because of light-scattering, the camera lens must be placed at a very small angle away from the direct beam. The short exposure required (100 to 200 μsec) is given by a xenon flash tube and the critical decision on the magnitude of the scattering angle to be used depends to some extent on the maximum amount of light energy which it is reasonable to expect to obtain from such a flash tube. An order-of-magnitude calculation of the flash-tube energy required is derived. These calculations show that a 10-joule flash is indicated as the bare minimum. A technique for conducting emulsion distortion tests is described and applied to various commercially available films. The most important part of the specification of the emulsion is concerned with the resolution; it is not vital that the very fastest emulsion should be used, and a medium-speed emulsion such as Panatomic X or Pan F is fast enough. Of the emulsions tested, Ilford S.E.B.C. gave the best resolution but was much too slow. Of the other emulsions, Ilford N.C.S. and Kodak Exp. were best. (BBB)

18196 A DEVICE FOR COUPLING A PULSE-HEIGHT DISCRIMINATOR TO A SCANNING X-RAY SPECTROMETER. K. Weber and J. Marchal (Euratom CCR Ispra, Italy). J. Sci. Instr., 41: 15-22(Jan. 1964).

A simple control device has been developed to synchronize a single-channel pulse height discriminator with the rotation of the crystal in an x-ray spectrometer over an energy range of 1 : 8. Both the bias voltage and the window width of the discriminator are continuously adjusted. The spectrometer had a 50 kv tungsten target x-ray tube, a LiF analyzing crystal and a scintillation counter. With this arrangement the line-to-background ratio for a wavelength of about 2.8 Å is improved by a factor of 33 compared with results obtained without a discriminator. Second-order reflections were attenuated within the whole waveband $0.35 < \lambda < 2.8$ Å by a factor of at least 60, and third-order reflections by a factor of at least 400. (auth)

18197 ELECTRON ATTACHMENT IN A NEON SPARK CHAMBER. J. U. Burnham and M. G. Thompson (Univ. of Durham, Eng.). J. Sci. Instr., 41: 108-10(Feb. 1964).

Measurements of the efficiency of a neon spark chamber, as a function of the amount of air contaminating the chamber, are reported. The results are shown to be consistent with a discharge model, and yield a value for the probability of attachment per collision for thermal electrons in air of 6.6×10^{-5}. (auth)

18198 A MASS SPECTROMETER DETECTOR USING TWO SEMICONDUCTOR MAGNETIC ELECTRON MULTIPLIERS. N. C. Fenner and R. G. Ridley (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Sci. Instr., 41: 157-9(Mar. 1964).

A semiconductor magnetic electron multiplier was constructed and its characteristics were evaluated using a mass spectrometer. A detector using two multipliers with variable separation was also constructed capable of comparing two ion beams simultaneously over a wide mass range. This double detector gave ratios near the statistical limits of accuracy when two isotopes of tungsten were analyzed using an ion beam with intensity varying greatly over short time periods. This electron multiplier has a wide field of application where small size and weight are an important consideration. (auth)

18199 SCINTILLATION COUNTER. B. Faldum. Kerntechnik, 6: 72-6(Feb. 1964). (In German)

The design and mode of operation of a scintillation counter are described. The luminous material, either an inorganic phosphor, an organic phosphor, or gas scintillator, is discussed. The photoelectron multiplier and the recording apparatus are described. The scintillation detector is compared with other radiation detection instruments. (M.C.G.)

18200 TRIAL MANUFACTURE OF RADIOACTIVE IONIZATION DETECTOR FOR HIGH SENSITIVE GAS-CHROMATOGRAPHY AND ITS CHARACTERISTICS. Tsugio Takeuchi and Daido Ishii (Nagoya Univ.). Kogyo Kagaku Zasshi, 66: 1299-1302(Sept. 1963). (In Japanese)

The design and performance of a radioactive ionization

detector with an α source for high-sensitivity gas chromatography are described. The detector exhibited high stability and sensitivity, the sensitivity for benzene in air being 2.46×10^7 mv/mg. A linear relationship between peak height and weight was maintained over a wide range for benzene, toluene, and n-hexane. The lowest detectable amount was 2×10^{-3} μg for benzene with a signal-to-noise ratio of 2:1. The detector also showed high sensitivity for inorganic gases such as H_2, O_2, and N_2. (from NSA of Japan)

18201 QUALITATIVE CHANGES IN MOUNTED Na(Tl) SCINTILLATION CRYSTALS UNDER THE INFLUENCE OF LARGE RADIATION DOSES. Rudolf Voszka (Inst. of Medical Physics, Budapest). Magy. Fiz. Folyoirat, 11: 205-7 (1963). (In Hungarian)

An attempt was made to determine the nature of changes in carefully grown and mounted NaI(Tl) crystals exposed to γ radiation from a ^{60}Co source. The amplitude and the resolving power, determined by means of a single-channel spectrometer and by comparison with a reference crystal were used to evaluate the reversible and irreversible changes. The mounted crystals were exposed to total doses ranging from 10^4 to 10^6 r. It was found that at doses higher than 10^4 r, the discoloration of the glass window of the mount causes a partially reversible worsening of the resolving power and the relative amplitude. After an exposure of about 3×10^5 r, the crystals reached a saturation value within about 300 hours, keeping it even after 3 months. However, by transferring the exposed crystals to a new mount, it was discovered that the discoloration of the glass window was responsible for the worsening of the characteristics; this was due to changes in the absorption of the glass in the region of luminescence of the crystal. It was concluded that in suitable mounting the investigated crystals may be used for the measurement of very large doses. (TTT)

18202 A METHOD FOR PREPARING STRONTIUM-90 SOURCES TO BE USED FOR THE DETERMINATION OF THE TIME OF RESOLUTION OF GM COUNTER SYSTEMS BY MEANS OF THE "PROPORTIONAL SOURCE" TECHNIQUE. Csaba Ujhelyi (Nuclear Research Inst., Debrecen, Hungary). Magy. Fiz. Folyoirat, 11: 245-8(1963). (In Hungarian)

A method was developed for the preparation of $^{90}SrCO_3$ sources having identical geometry, so that their activity ratio can be determined with an accuracy better than 0.1%. The thickness of the layers, deposited from a mother solution with a specific activity of about 0.01 μC/g, was 207.6 mg of $SrCO_3/cm^2$. The geometric similarity of the sources, which possessed nearly identical activities, was determined by means of careful activity measurements; no deviation could be found from the activity ratio based on mass spectroscopic measurements. A G-M tube with a 28 mg of Al/cm^2 window was used for the measurements, the reliability of which was confirmed by time resolution determinations. (TTT)

18203 RADIOACTIVE SELF-LUMINOUS COMPOUNDS. IV. COMPARISON OF RELATIVE LUMINESCENCE EFFICIENCIES OF RADIO-LUMINESCENCE AND PHOTOLUMINESCENCE OF VARIOUS PHOSPHORS. Yasuro Ato and Ryoitiro Huzimura (Government Industrial Research Inst., Nagoya, Japan). Nagoya Kogyo Gijutsu Shikensho Hokoku, 12: 482-8(Oct. 1963). (In Japanese)

A comparison was made of the relative luminescence efficiencies of various phosphors such as ZnS, ZnCdS, Zn_2SiO_4, and $CaWO_4$ excited by α rays from ^{210}Po, β rays from ^{90}Sr–^{90}Y, and 3650 Å uv light. The influence of the structure of phosphors on the efficiency was noted. ZnS-type phosphors generally showed the highest efficiencies under all types of excitation. Among ZnS–CuS-type phosphors, the specimen fired at 1100°C was the most efficient under the 3 types of excitation. A highly efficient phosphor in photoluminescence was not always efficient in radioluminescence. The addition of a flux was generally effective for radioluminescence as it was for photoluminescence. The phosphors fired in H_2S showed a lower efficiency than those fired in air or N_2 in both radio- and photoluminescence. (from NSA of Japan)

18204 NEUTRON DETECTION AND ANALYSIS USING A SCINTILLATION BUBBLE CHAMBER. R. C. Minehart and R. H. Milburn (Harvard Univ., Cambridge, Mass.). Nucl. Instr. Methods, 25: 13-25(Dec. 1963).

The construction and operation of a scintillation bubble chamber system are described and an experimental application to the detection and analysis of high energy neutrons is reported. It is shown that neutron-induced events confined to the bubble chamber fluid can be correlated electronically with external scattering interactions detected by scintillation counters. Application to high-energy neutron polarization analysis is discussed. (auth)

18205 STABILISATION OF A GAMMA-RAY SPECTROMETER. I. Dixon (Univ. of Dublin). Nucl. Instr. Methods, 25: 26-8(Dec. 1963).

A simple stabilizer, suited for low-level counting, is described. The total counts on two kicksorter channels are used to control the photomultiplier voltage. Stability factors in the range 700 to 900 have been obtained. (auth)

18206 FAST NEUTRON SPECTROMETER. R. Potenza and A. Rubbino (Università, Catania, Italy). Nucl. Instr. Methods, 25: 77-88(Dec. 1963).

A fast neutron spectrometer consisting of a wide suitably shaped converter sheet and a silicon junction detector is described. Efficiency and resolving power are calculated and experimentally checked using mylar and polyethylene radiators. Screening of the detector against direct neutrons yields a good signal to noise ratio. The energy spectrum of neutrons from a Po–Be source is measured and the comparison with the known data discussed. (auth)

18207 CALCULATION OF FLAT-RESPONSE FAST-NEUTRON DETECTION SYSTEMS EMPLOYING FINITE SIZE BF_3-COUNTERS. H. H. Thies (Univ. of Western Australia, Perth). Nucl. Instr. Methods, 25: 89-92(Dec. 1963).

Making the assumption that ϕ (the rate at which neutrons are emitted from a source) is proportional to the volume integral of the slow neutron density throughout the moderator, one can calculate a weighting function $f(\vec{r})$. The weighting function is independent of the energy spectrum of the source neutrons. The calculation is demonstrated by a sample calculation of a flat-response fast neutron detection system. (auth)

18208 THE α/β RATIO OF SEVERAL ORGANIC SCINTILLATORS. J. B. Czirr (Univ. of Washington, Seattle). Nucl. Instr. Methods, 25: 106-8(Dec. 1963).

The pulse-height response of organic scintillators to α and β particles has been measured in an effort to find the optimum detector of neutrons in the Mev region. The 5.3-Mev α particles from ^{210}Po were used to simulate the knock-on protons produced under neutron irradiation. The pulse height response of several plastic and liquid scintillators is compared to that of a commercially available product. (auth)

18209 A SONIC SPARK CHAMBER FOR A MAGNETIC SPECTROGRAPH. D. L. Allan (Atomic Research Establishment, Harwell, Berks, Eng.). Nucl. Instr. Methods, 25: 118-24(Dec. 1963).

A sonic spark chamber intended to replace the photographic plate in a broad range magnetic spectrograph is described. In this instrument, a charged particle arriving at the focal plane of the spectrograph produces a spark very close to its point of entry. The exact position of this point is then located by an ultra-sonic sound ranging technique and a spectrum of the particle intensity variation along the focal plane is automatically recorded and displayed on a multichannel time analyzer. The results of tests with this instrument operating inside a magnetic spectrograph and recording 6-Mev α particles and 5 to 9.5 Mev protons are given. (auth)

18210 DESIGN AND PERFORMANCE OF RECTANGULAR LARGE-AREA SCINTILLATION COUNTERS. M. A. Meyer and N. S. Wolmarans (Potchefstroom Univ. for C.H.E., South Africa). Nucl. Instr. Methods, 25: 134-40 (Dec. 1963).

The design and the problem of light collection from large-area scintillation counters are discussed. A new method of light collection is employed to collect the light from a large-area scintillation counter. It is shown that, employing this method of light collection and two RCA 5819 photomultipliers, the response of a scintillation counter of area 100×35 cm^2 is uniform to within 10% except in the corners near the photomultipliers where the average pulse height increases to about 30% above the value near the center of the scintillation counter. The design presented suggests that reasonable uniformity can be obtained in a scintillation counter having an area of 1 m^2 employing three RCA 5819 photomultipliers. (auth)

18211 β-SCINTILLATION SPECTROMETRY WITH CsI(Tl) AS SCINTILLATOR. K. Gleu, F. Hoyer, and K. H. Koenig (Universität, Frankfurt am Main). Nucl. Instr. Methods, 25: 149-56(Dec. 1963). (In German)

During work on the properties of CsI(Tl)-scintillation crystals and their use for β-spectroscopy it was found that these crystals have essential advantages at least for radiochemical purposes compared with the usual scintillation materials. The form of β-spectra measured with CsI(Tl)-crystals, which deviates strongly from theory, could be explained to result undoubtedly from backdiffusion of β-radiation out of the crystal. However, these changes of the spectral distribution have the great advantage that β maximum energies can often be directly extrapolated with sufficient accuracy without working out a Fermi-Kurie-plot even when some different β-groups superimpose in the spectrum. A radiochemist's demand for a safe and relatively simple method suitable for quick control of separation problems can be satisfied without large mathematical apparatus by the described method. (auth)

18212 ČERENKOV SPECTROMETER FOR MEASURING GAMMA-RAY ENERGIES. M. N. Hachaturjan and V. S. Pantujev (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instr. Methods, 25: 173-6(Dec. 1963).

The calibration experiment is described of a full absorption Čerenkov counter made of lead glass for energy measurements of γ quanta and electrons with energies of several Bev. The counter has been tested by monoenergetic electrons within the energy range between 0.5 and 3.0 Bev. The Čerenkov counter pulse amplitude versus electron energy follows a linear law within the indicated energy range. The energy resolution of the spectrometer, determined as the ratio of pulse amplitude distribution curve half-width to pulse amplitude at the distribution maximum, for 1.0 Bev electrons has been measured to be 29%. (auth)

18213 DIFFERENT MODES OF FUNCTION, IN AIR, OF SCINTILLATION COUNTERS OF THE (FIL-PLAN) TYPE. D. Blanc and J. Maurel (Centre de Physique Nucléaire, Toulouse). Nucl. Instr. Methods, 25: 177-8 (Dec. 1963). (In French)

The various operating regions (as a function of interelectrode voltage) are studied for spark chambers having a filament anode parallel to a planar cathode, operating in air. The interelectrode spacing is variable. (T.F.H.)

18214 A HIGH-RESOLUTION LITHIUM-DRIFT GERMANIUM GAMMA-RAY SPECTROMETER. A. J. Tavendale and G. T. Ewan (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Instr. Methods, 25: 185-7(Dec. 1963).

The performance of a Ga-doped, Li-drifted Ge detector (resolution = about 0.5%) used as a gamma spectrometer is detailed. Results obtained on the gamma spectrum of ^{177}Yb are reported. (T.F.H.)

18215 AUTOMATIC DATA RECORDING SYSTEM FOR THE NEUTRON SPECTROMETER ON THE MERLIN RESEARCH REACTOR. R. Winkworth (A.E.I. Research Lab., Aldermaston, Berks, Eng.). Nucl. Instr. Methods, 25: 288-96(Jan. 1964).

A neutron spectrometer has been built as an experimental facility on the MERLIN research reactor. The control system for this spectrometer provides for automatic operation following a predetermined program. The automatic data recording system described here forms a subsystem in the spectrometer control system, but it could be used independently in any experimental application requiring recording of scaler readings. It accepts data from two types of scaler, together with switch-coded data, and produces a written record. Extensive use is made of semiconductors in conjunction with conventional relay circuitry. A 500 cps digit frequency is used, with decimal logic and storage using cold-cathode decade tubes. Certain simple arithmetical operations can be performed automatically on the data. (auth)

18216 STABILIZATION OF A GAMMA SCINTILLATION SPECTROMETER AGAINST ZERO AND GAIN DRIFTS. R. A. Dudley and R. Scarpatetti (International Atomic Energy Agency, Vienna). Nucl. Instr. Methods, 25: 297-313(Jan. 1964).

In this paper is described the theory, design, and performance of a device, which corrects zero and gain drifts of any origin in a gamma-ray scintillation spectrometer consisting of NaI(Tl) crystal and multichannel pulse-height analyzer. This correction is automatic and continuous throughout operation of the spectrometer. Stability of peak channel numbers to 0.1 percent or better seems attainable over indefinite periods of time without important penalties. Reference gamma rays, having low and high energies respectively, and accompanied always by coincident beta rays which uniquely distinguish them from all other gamma rays, are emitted from a special source close to the detector. The spectrometer determines the channel number of these reference gamma rays as for other gamma rays, but does not store the counts in its memory. The stabilization device adjusts zero and gain, by means of feedback voltages applied to analyzer window threshold and photomultiplier dynode voltage, respectively, so as to hold the two reference peaks always in the preassigned channels. Thus the same reference spectrum is used for all experimental spectra (without, however, contributing appreciably to background), and the stabilization feedback loop encom-

passes the entire analog portion of the spectrometer. (auth)

18217 $\pi\sqrt{2}-\beta$-SPECTROMETER WITH DOUBLE FOCUSING. H. U. Gersch, E. Hentschel, P. Gippner, and W. Rudolph (Zentralinstitut fur Kernphysik, Rossendorf, Ger.). Nucl. Instr. Methods, 25: 314-16(Jan. 1964). (In German)

A $\pi\sqrt{2}$ β spectrometer has been constructed in which the beam of electrons is focused twice. In order to use a maximum solid angle, a penetration of the two beams of electrons is partly necessary. The increase of background counts at the second focus, however, has no disadvantages for this arrangement. (auth)

18218 A NEW BETA-RAY SPECTROGONIOMETER FOR ANGULAR CORRELATION MEASUREMENTS. M. Sakai, H. Ikegami, and T. Yamazaki (Tokyo Univ.). Nucl. Instr. Methods, 25: 328-32(Jan. 1964).

A new beta-ray spectrogoniometer for electron-electron angular correlation measurements was designed and constructed. It consists of two sector-type double-focusing spectrometers. Design of the apparatus and data of performance are described. As an example, an electron-electron directional correlation function of the ^{206}Pb gamma-gamma cascade obtained with this instrument is presented. (auth)

18219 NEUTRON EFFECTS IN A 2″ × 2″ NaI(Tl) SCINTILLATION SPECTROMETER. L. C. Thompson (Univ. of Georgia, Athens). Nucl. Instr. Methods, 25: 333-7(Jan. 1964).

The absolute spectral response of a 2 × 2 in. NaI(Tl) crystal to monoenergetic neutrons of 0.205, 0.925, 3.05, and 15.08 Mev energy is presented. The number of counts/Mev per neutron/cm^2 incident on the front face of the crystal is plotted as a function of pulse height. For neutrons of 0.205 and 0.925 Mev, the counts due to ^{128}I activity are separated from the prompt gamma rays. (auth)

18220 SCINTILLATION SPECTROMETER FOR α- AND β-RADIATION. K. H. Koenig, F. Hoyer, and E. Krebs (Johann Wolfgang Goethe-Universitat, Frankfurt am Main). Nucl. Instr. Methods, 25: 338-42(Jan. 1964). (In German)

A scintillation spectroscopy assembly for simultaneous spectroscopy of α- and β-ray emitting isotopes as separated in radiochemical experiments is described. In a light-safe chamber the radiation hits in vacuo a cesium-iodide scintillator at nearly total 2π-geometry. The scintillations are registered by a photomultiplier, which is situated outside the vacuum-system, but an optical contact with the CsI(Tl)-crystal. The amplified signals are analyzed in the usual way. (auth)

18221 SOME REMARKS ON SCANNING EFFICIENCY. K. K. M. Wu, B. S. K. Chow, Ruth Lim, and V. D. Hopper (Univ. of Melbourne). Nucl. Instr. Methods, 25: 343-8 (Jan. 1964).

Several nuclear emulsion plates have been triple scanned for nuclear interaction stars. Triple scanning showed that stars of different types had nearly similar intrinsic probabilities of being detected applying the Tolstov test. However, the estimated number of stars using the double scanning method and the average value from triple scanning were below the total number of stars found by the three scannings n_{1+2+3}. A method was suggested to classify the stars into two groups each of different intrinsic probability. With this classification and with the consideration of the effect of the positions of stars in their fields of view on their efficiencies, the double scanning method was found to give an estimated total number above n_{1+2+3}. (auth)

18222 RECOIL COUNTING WITH SURFACE BARRIER SEMI-CONDUCTORS. R. L. Wolke and V. J. Sodd (Univ. of Pittsburgh). Nucl. Instr. Methods, 25: 357-61 (Jan. 1964).

A method is described by which recoiling residual nuclei from nuclear reactions are counted and analyzed with good resolution as they escape from thin targets during accelerator bombardments. The properties of the silicon surface barrier detectors used are described. Spectra of 1 to 8 Mev ^{10}B, ^{12}C, ^{13}C, and ^{13}N recoils from 15-Mev deuteron-induced reactions of carbon have been obtained as a function of detector bias, target thickness, and thickness of interposed absorber. Applications of the method to studies of the range, energy loss, and charge-state distributions of low energy heavy ions, and low energy nuclear reaction mechanisms are described. (auth)

18223 IONIZATION MEASUREMENTS OF DIFFUSION CLOUD-CHAMBER TRACKS. G. Piragino (Universita, Turin). Nucl. Instr. Methods, 25: 362-4(Jan. 1964).

An application of the relative photometric method for measuring the ionization of tracks in diffusion cloud-chamber pictures is described. One shows the possibility to recognize the proton and π-meson tracks from their momentum and ionization measurements in many cases when their visual identity is ambiguous. The results are also in good agreement with the known ionization energy loss of the π-mesons as a function of their momenta. (auth)

18224 USE OF THE ASSOCIATED PARTICLE METHOD IN THE CASE OF A PULSED NEUTRON SOURCE. A. Adam, G. Palla, E. Pasztor, and P. Quittner (Central Research Inst. of Physics, Budapest). Nucl. Instr. Methods, 25: 365-6(Jan. 1964).

The combination of the pulsed-source and associated-particle techniques of neutron time-of-flight spectroscopy is discussed, for the case in which neutrons from T(d,n)^{4}He are used as the source. (T.F.H.)

18225 A "WINDOW FILTER" FOR NEUTRON SPECTROMETRY. P. K. Iyengar (Atomic Energy Establishment, Trombay, India). Nucl. Instr. Methods, 25: 367-9 (Jan. 1964).

A "window" neutron filter, consisting of a pair of filters of different materials (e.g., Be and BeO), is described. The filters are polycrystalline, and must contain only coherently scattering nuclei. Uses for the filter are described. (T.F.H.)

18226 SUB-NANOSECOND TIMING WITH SEMICONDUCTOR DETECTORS. C. W. Williams and J. A. Biggerstaff (Oak Ridge National Lab., Tenn.). Nucl Instr. Methods, 25: 370(Jan. 1964).

A technique is described for achieving better than 1 nsec timing resolution in a semiconductor system, without degrading its energy resolution performance. The technique consists of transformer-coupling a fast amplifier and discriminator in series with a charge-sensitive amplifier, which is used as the first element of a pulse-height analysis system. (T.F.H.)

18227 METHOD FOR REDUCING A BACKGROUND TAIL IN INELASTIC SCATTERING EXPERIMENTS BY A MAGNETIC ANALYZER SYSTEM. K. Yagi (Tokyo Univ.). Nucl. Instr. Methods, 25: 371-2(Jan. 1964).

The background tail arising from the elastic scattering of the tail of an incident proton beam by the target is discussed, with particular attention to its removal from the inelastic-scattering measurements. This removal is accomplished by the inclusion of a supplementary magnetic beam analyzer into the beam analyzer system. (T.F.H.)

18228 ON THE MULTIPLICITY EFFECT IN A STANDARD COSMIC-RAY NEUTRON MONITOR. F. Bachelet, P. Balata, E. Dyring, and N. Iucci (Universita, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nuovo Cimento (10), 31: 1126-30(Mar. 1, 1964).

A multiplicity effect in the neutron monitor record, caused by separate detection of evaporation neutrons that diffuse in paraffin with a time spread, is discussed. Its possible variation with latitude, altitude, and solar activity, and the errors introduced in the Poisson-distribution assumption are considered. An automatic transistor device is described for integral analyses of the multiplicity distribution. (R.E.U.)

18229 MEASUREMENT OF X-RAY AND ULTRAVIOLET RADIATION BY THERMO-LUMINESCENT PHOSPHOR, $CaSO_4$(Mn). T. V. Kazachevskaya, V. A. Arkhangel'skaya, G. S. Ivanov-Kholodnyi, V. S. Medvedev, T. K. Razumova, and A. V. Chudaikin. Planetary Space Sci., 12: 167-74(Feb. 1964).

Translated by O. M. Blunn from Iskusstv. Sputniki Zemli, Akad. Nauk SSSR, No. 15, 71(1963).

The apparatus and results are discussed for rocket measurements of the energy distribution and the total energy in the x-ray region of the solar spectrum. The short-wave radiation is recorded by thermoluminescent phosphor. The phosphor stores the energy of the short-wave radiation and on heating reradiates it in the visible region. $CaSO_4$(Mn) is insensitive to radiation of $\lambda > 1300$ Å. (R.E.U.)

18230 THE TOTAL EFFICIENCY FOR γ-RAY OF NaI(Tl) PHOSPHOR. Shinji Okano (Inst. of Physical and Chemical Research, Tokyo). Radioisotopes (Tokyo), 12: 253-7(May 1963). (In Japanese)

The total scintillation efficiencies of cylindrical NaI(Tl) phosphors for γ rays of 0.06 to 20.0 Mev are calculated. The total scintillation efficiency is the product of the intrinsic efficiency and the geometric efficiency of the phosphor. The phosphors varied in height from 1 to 3 in. and in radius from 0.5 to 1.5 in. Point sources of γ rays were placed on the axes of the cylinders above or inside the cylinders at distances of 0.0 to 20.0 cm from the phosphors. Results are presented in tables and graphs. (from NSA of Japan)

18231 THE EFFICIENCY OF NaI(Tl) PHOSPHOR IN THE PHOTOELECTRIC PEAK RANGE. Shinji Okano (Inst. of Physical and Chemical Research, Tokyo). Radioisotopes (Tokyo), 12: 258-60(May 1963). (In Japanese)

Photoelectric peak efficiencies of NaI(Tl) phosphors were calculated for various geometries of phosphors in the γ-ray energy range 0 to 4 Mev. The ratios of peak to total efficiencies were calculated using the Monte Carlo method. Two special cases are discussed: the γ-ray source is placed parallel to the axis of the cylindrical phosphor, and a point source is placed on the axis of the cylindrical phosphor. (from NSA of Japan)

18232 THE SHAPES OF THE SCINTILLATION γ-RAY SPECTRA AND MEASURING CONDITIONS. Shinji Okano (Inst. of Physical and Chemical Research, Tokyo). Radioisotopes (Tokyo), 12: 261-5(May 1963). (In Japanese)

Scintillation γ-ray spectra of various nuclides are examined. It is shown that the shapes of the spectra are varied, even for the same nuclide, by the geometries and dimensions of the γ-ray sources and the phosphors and their relative positions. Phosphors of NaI(Tl) with varying geometries are used. The γ-ray sources examined are ^{22}Na, ^{54}Mn, ^{60}Co, ^{65}Zn, and ^{137}Cs. The counts vs wave-height curves are shown. (from NSA of Japan)

18233 DESIGN OF ^{3}He-FILLED FAST PROPORTIONAL COUNTERS. J. L. Friedes and R. E. Chrien (Brookhaven National Lab., Upton, N. Y.). Rev. Sci. Instr., 35: 469-72 (Apr. 1964). (BNL-7656)

Electron drift velocity measurements have been made on helium, helium−CO_2, and helium−CH_4 mixtures in order to determine the optimum design parameters for ^{3}He-filled proportional counters. It is shown that small (< 1-in.-dia.) counters with neutron detecting efficiencies of greater than 1% at 1 kev and with jitter times of less than 1 μsec are practical. Calculated and measured jitter times for several counters are compared. (auth)

18234 SPARK CHAMBER DATA-HANDLING SYSTEM USING TELEVISION CAMERAS. Herbert L. Anderson and Arpad Barna (Univ. of Chicago). Rev. Sci. Instr., 35: 492-5 (Apr. 1964).

A spark chamber data recording system directly compatible with an IBM 7094 computer is described. The basic information-gathering elements are two closed-circuit television cameras scanning parallel to the spark chamber plates. The spark coordinates are digitized and recorded on digital magnetic tape. Basic considerations, operation, and results of linearity and cosmic ray tests are given. (auth)

18235 MULTIPLATE SHOWER COUNTER FOR HIGH ENERGY GAMMA RAYS. S. Homma, R. Kikuchi, and T. Kitagaki (Tohoku Univ., Sendai). Rev. Sci. Instr., 35: 506-8(Apr. 1964).

A type of total absorption photon counter was constructed and calibrated. It is a multiplate shower detector composed of seventeen 10-mm-thick sheets of plastic scintillator, sandwiched by sixteen 3-mm-thick sheets of lead. The total radiation length of the counter is 9.5 radiation lengths. The scintillation light produced in the plastic sheets is detected by four phototubes. The two counters constructed were calibrated by using electrons over the energy range from 60−600 Mev, and they showed the same characteristics. The energy response of the output pulse height from either counter is nearly proportional to the energy of incident electrons over the range studied, and the energy spread of the counter, defined by the full-width of the distribution at the half-maximum, ΔE over E, is about 30% at 600 Mev and proportional to $E^{-\frac{1}{2}}$. (auth)

18236 FLEXIBLE LIGHT PIPES. Neville W. Reay and Larry M. Preston (Univ. of Rochester, N. Y.). Rev. Sci. Instr., 35: 519(Apr. 1964).

A flexible light pipe was devised for coupling between a photomultiplier tube and a scintillator. The light pipe comprises a convoluted Neoprene rubber tube coated on the inside with titanium oxide pigment in a vinyl base and filled with glycerine. The glycerine is separated from the photomultiplier by a short Lucite section. The flexible pipe attenuates the pulse height by a factor of two compared to straight, polished Lucite, but for bends up to 45° maintains a pulse height constant within 5%. (D.L.C.)

18237 CERTAIN FEATURES OF α-PARTICLE COUNTING WITH TYPE I DIAMONDS. E. A. Afanas'eva and E. A. Konorova (Lebedev Inst. of Physics, Moscow). Soviet Phys.-Solid State (English Transl.), 5: 1866-9 (Mar. 1964).

It is shown that so-called type I diamonds may be used to count α particles. The counting mechanism is different from the mechanism proposed previously for diamonds of type IIa. There exists a certain threshold voltage at which the rate of counting and the pulse height due to individual particles increase rapidly. Because of this, it is assumed

that field emission from electrodes into crystals takes part in the observed phenomena. (auth)

18238 STUDY OF THE MEASUREMENT OF RADIATIONS WITH METALLIC AND SEMICONDUCTOR BOLOMETERS. Ervin Dezsoe. Studia Univ. Babes-Bolyai, Ser. Math. Phys., 8: No. 2, 107-16(1963). (In Rumanian)

A comparative study of metallic and semiconductor bolometers shows that their sensitivity generally depends on the optic, thermal, and electrical properties of the bolometer material and on the selection of the dimensions of the bolometer. The factors affecting the sensitivity were examined. For maximum sensitivity, 50% of the incident energy must be absorbed. Better sensitivity can be obtained with semiconductor bolometers than with metallic bolometers. (D.C.W.)

18239 FEASIBILITY OF ASPIRATION METHODS FOR MEASURING ATMOSPHERIC RADIOACTIVITY. N. N. Aleksandrov. Tr. Gl. Geofiz. Observ., No. 138, 42-55(1963). (In Russian)

The design is given of a portable filter-ventilation radiometer for measuring and calculating radioactivity in air. Results obtained using the radiometer are analyzed. (tr-auth)

18240 AIR-FILLED SPARK DETECTORS FOR RECORDING PARTICLE SHOWERS. M. I. Daion and L. F. Klimanova (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 45: 2078-80(Dec. 1963). (In Russian)

A description is given of an air–argon-filled spark counter capable of recording several particles. The counter consists of six discharge intervals, with one metal electrode and one metal-coated glass electrode in each interval. A table is included showing the efficiency of each interval at various high-voltage pulse delays. The results showed that the chambers possess a good memory with good trajectory localization and high particle recording efficiency. (R.V.J.)

18241 OPTICAL PROBLEMS IN THE DESIGN OF LARGE LIGHT-LIQUID BUBBLE CHAMBERS. W. T. Welford. p.173-92 of "Proceedings of Conference on Optical Instruments, 1961." London, Chapman and Hall, 1962.

A discussion is presented of the three main optical problems that occur with large bubble chambers using low-refractive-index liquids such as hydrogen, deuterium, or helium. These problems arise from: the light-scattering function of the bubbles; the large depth chamber to be photographed; and the desired precision of measurement. Very little light is scattered except in directions close to the incident beam; thus a dark-ground viewing system using light scattered a few degrees away from the main beam must be used; this requires carefully designed aspheric condensers and high-efficiency antireflection coating to keep direct light away from the camera lenses. Chamber depths of 400 to 500 mm are being envisaged; in order to photograph through such a great depth it might be necessary to stop down the camera lenses to a point at which the resolution is limited by the lens rather than the photographic emulsion. Proposals for coping with this difficulty are discussed. Measurements of track image positions on the film are physically significant to an accuracy of a few microns; the camera design problems posed by this precision are described. Arrangements of the camera and specification of the lenses are considered. (BBB)

18242 SYNTHESIS OF NUCLEAR EMULSIONS SENSITIVE TO RELATIVISTIC PARTICLES. Tsu-yin Lu, Hang-cheng Sen, and Wei-chang Liu. p.142-6 of "Yadernye Fotografiya." Moscow, Publishing House of the Academy of Sciences, 1962.

The principles of production and basic properties of the type Ya-4 nuclear emulsion, sensitized with gold, are described. Intensifying the surface centers of sensitivity and increasing the coefficient of utilization of the liberated electrons, as well as the observance of the principle of grain homogeneity, were used as means to increase the sensitivity of the silver halide to charged particles. (TCO)

18243 FAST NEUTRON SPECTROMETER USING SPACED SEMICONDUCTORS FOR MEASURING TOTAL ENERGY OF NEUTRONS CAPTURED. T. A. Love and R. B. Murray (to U. S. Atomic Energy Commission). U. S. Patent 3,129,329. Apr. 14, 1964.

A fast neutron spectrometer was designed, which utilizes a pair of opposed detectors having a layer of ^{6}LiF between to produce α and T pair for each neutron captured to provide signals, which, when combined, constitute a measure of neutron energy. (AEC)

18244 NUCLEAR RADIATION DOSIMETER USING COMPOSITE FILTER AND A SINGLE ELEMENT FILTER. Ellery Storm and Simon Shlaer (to U. S. Atomic Energy Commission). U. S. Patent 3,130,306. Apr. 21, 1964.

A nuclear radiation dosimeter is described that uses, in combination, a composite filter and a single element filter. The composite filter contains a plurality of comminuted metals having K-edges evenly distributed over the energy range of interest and the quantity of each of the metals is selected to result in filtering in an amount inversely proportional to the sensitivity of the film in the range over 100 kev. A copper filter is used that has a thickness to contribute the necessary additional correction in the interval between 40 and 100 kev. (AEC)

18245 METHOD OF COMPENSATING THE ENERGY DEPENDENCE OF SCINTILLATION DOSIMETERS. A. N. Denisenko. Russian Patent 159,238.

A method for compensating the energy dependence of scintillation dosimeters is described. To utilize the linear dependence of the pulse amplitude on the radiation energy, the pulse from the output of the photomultiplier is converted into a control signal and then fed to the input of the photomultiplier to adjust its current in the direction of the energy dependence. (AID Press)

18246 METHOD OF DETERMINING DEAD TIME FOR PROPORTIONAL GAS COUNTERS OR SCINTILLATION COUNTERS. V. K. Lyapidevskii and A. N. Denisenko. Russian Patent 159,239.

A simplified method for determining the dead time of proportional or scintillation counters is described. Simultaneous measurements are made of the number of pulses per unit time and of the integral detector current. The dead time of the counter is determined according to the change in the ratio of the integral current of the detector and the number of pulses per unit time during change of radiation power. (AID Press)

ISOTOPE TECHNOLOGY

General

18247 (KFK-184) PRESENT STATUS AND FUTURE PROSPECTS OF PRODUCTION AND UTILIZATION OF RADIOISOTOPES IN GERMANY. K. Wirtz (Kernforschungszentrum. Institut fur Neutronenphysik und Reaktortechnik, Karlsruhe, Germany). Nov. 1963. 26p. (CONF-447-1)

For Presentation at 5th Japan Conference on Radioisotopes, Tokyo, May 1963.

The history of radioisotopes in Germany is reviewed. The regulations and present isotope distribution in the Federal Republic are outlined. Some statistics are given on the imported radionuclides and their use. Laboratories for handling multicurie sources are considered. Radioisotope production in research reactors and cyclotrons and the production of labeled compounds are discussed. Future prospects and the problems of transporting radioactive materials are discussed. (D.L.C.)

18248 ISOTOPES AND RADIATION TECHNOLOGY. Volume 1, Number 2. P. S. Baker, Robert H. Lafferty, Jr., and Martha Gerrard, eds. (Oak Ridge National Lab., Tenn.). Winter 1963-1964. $0.55(GPO) (Domestic), $0.70(GPO) (Foreign). (One of the Technical Progress Reviews prepared quarterly for the Division of Technical Information, USAEC). 85p.

Progress in the fields of isotopes and radiation technology is reported under the following topics: isotope production and development, isotope technology development, AEC program on low-dose irradiation processing of food, process radiation development, source development, safety, and miscellaneous items of interest. Separate abstracts were prepared for 12 papers presented under these topics. (M.C.G.)

For abstracts of individual papers see: 17526, 17688, 17889, 18016, 18080, 18254, 18263, 18264, 18265, 18323, 18513, and 19436.

Industrial Applications

Refer also to abstract 17620.

18249 (BNL-810) STUDY REPORT [OF] COBALT-60 BULK GRAIN IRRADIATOR. (Vitro Engineering Co., New York). June 30, 1963. For Brookhaven National Lab., Upton, N. Y. Contracts AT(30-2)-Gen-16 and S-1497. 50p.

Results are presented of a study to conceive, evaluate, review, and estimate costs for a number of suitable designs for a cobalt-60 Bulk Grain Irradiator; select a preferred type; and establish required criteria for future detail design and construction of the selected concept. Three irradiator concepts are described. The irradiators discussed are sized to function as a pilot plant in an agricultural experiment station. Particular attention is given to scale-up capability, so that the same performance characteristics can be obtained for commercial utilization, without penalty to the usefulness of the irradiator as an experimental tool. A single concept, designated as the continuous-grid source concept, is selected as most promising because of its high efficiency, exceptional versatility, acceptable cost, ease of maintenance, good reliability, and inherent simplicity. (auth)

18250 A METHOD FOR CHOOSING γ-EMITTERS USED TO CONTROL THE DENSITY OF ORE PULPS CONTAINING MATERIALS WITH ATOMIC NUMBERS LESS THAN 30. M. L. Gol'din. At. Energ. (USSR), 16: 71-2(Jan. 1964). (In Russian)

When choosing the γ sources used in the control and measurement of the density of pulps and other suspensions during ore treatment, or metallurgical or chemical processing, the half life and the energy of the emitted γ quanta must be taken into consideration. In order to eliminate the effect of chemical composition changes induced by the radiation, the quanta emitted should be absorbed only by means of the Compton effect. A formula was derived, by means of which it is possible to evaluate the effect of the various parameters; these were calculated for ^{60}Co, ^{134}Cs, ^{137}Cs, and ^{125}Sb, the half lives of which exceed 2 years. The results indicated that ^{137}Cs is the most suitable γ source for measuring the density of ore pulps containing solid components with an order number below 30. (TTT)

18251 THE APPLICATION OF RADIOISOTOPES TO THE CHEMISTRY OF PESTICIDES AND PLANT PROTECTION. W. Dedek (Institut für Angewandte Radioaktivitat, Leipzig). Atompraxis, 10: 65-70(Feb. 1964). (In German)

A review is given on the use of radioisotopes in pesticides and plant protection. 253 references are included. (P.C.H.)

18252 PROPERTIES OF GRAFT COPOLYMERIZED CELLULOSE FIBER. I. STYRENE GRAFTED COTTON. Waichiro Tsuji, Masazo Imai, and Yoriko Kadono (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 42: 68-76 (Jan. 1964).

Styrene was graft copolymerized onto cotton by high energy radiation and some properties of the grafted cotton were studied. It was found that excellent thermoplasticity, dimensional stability, and water repellency were given to cotton by this graft copolymerization without appreciable decreasing of the mechanical properties. (auth)

18253 RAILWAY SIGNALLING SYSTEMS USING RADIOISOTOPES LOCATED ON TRACKS AND THE CONTINUATIVE CHECKING OF THEIR ACTIONS BY COSMIC RAY BACKGROUND RADIATION. Akira Kobayashi (Japanese National Railways). Genshiryoku Kogyo, 9: No. 10, 8-16(Oct. 1963). (In Japanese)

Preliminary tests on several types of radioisotope signalling systems are reported, including an axle counter, a recorder of the interception of γ rays by passing trains, and a Bremsstrahlung detector utilizing absorption of ^{90}Sr radiation by passing trains. A radiation-reflection train detector was also tested as an approach signal for high-speed trains. The device uses γ rays scattered from a passing train to activate a relay located beside the ^{137}Cs source. For fail-safe operation, a system of duplicate Geiger counters and circuits is used to feed cosmic-ray background pulses to a monitoring relay, which gives a warning indication of the failure of a Geiger tube or circuit. (from NSA of Japan)

18254 RADIOISOTOPE MEASUREMENT AND CONTROL SYSTEMS. Isotopes Radiation Technol., 1: No. 2, 160-74(Winter 1963-64).

Commercial radioisotope measurement systems, developed for use in many applications, such as bulk density, liquid density, thickness of sheets, and firmness of cigarettes, are described. The basic principles of these instru-

ments are reviewed. The following developments in the use of gamma backscatter gages are described: a gage for measuring the thickness of heat-exchanger tubing by inserting a probe in the inside of the pipe; a modification of a commercial coal density gage to give it a more linear response and to make it less sensitive to the composition of the coal; and the detection of defects in logs by gamma backscattering. A double-beam gamma density gage was developed for use in a mass flowmeter. Gages for measurement of density of silage and of the atmosphere from 45,000 to 150,000 ft are also described. (M.C.G.)

18255 RADIOACTIVE ISOTOPES IN NEW YORK STATE INDUSTRY. Edwin Wiggin. Albany, New York State Office of Atomic Development, 1963. 92p.

Basic concepts necessary for an understanding of the role of radioisotopes in industry are presented as the answers to 12 questions. Applications of radioisotopes for gaging, radiography, ionization and luminescence, and high-intensity sources for purposes such as food preservation and radiation-induced polymerization are discussed. Health and safety are briefly considered. (H.M.G.)

Power Application

Refer also to abstract 18624.

18256 (TID-20432) POTENTIAL REQUIREMENTS FOR FISSION PRODUCTS AS HEAT AND RADIATION SOURCES. (Division of Isotopes Development, AEC). Jan. 1964. Includes Appendix: ECONOMIC COMPARISON OF THE USE OF FISSION PRODUCTS AND OTHER ENERGY SOURCES IN POWER APPLICATIONS. Feb. 1964. 30p.

An outline is presented of the potential applications and quantity requirements of fission products for the period 1964 to 1968. These applications include military, government, and civilian heat sources; irradiation processing; and food irradiation. The potential requirements for 1964 to 1968 are 273 MC ^{90}Sr and 351 MC ^{137}Cs. An evaluation is made of the applications of heat-producing isotopes in Coast Guard navigational buoys, lights, and beacons; undersea electronic systems; and weather stations. Costs were determined for conventional methods of power generation and compared to radioisotope power generation. Fuel requirements and break-even fuel costs for isotopic power are tabulated. (D.L.C.)

Separation and Production

18257 (NP-13766(p.7-26)) EXAMEN DES AMELIORATIONS RECENTES PROPOSEES PAR LES AMERICAINS DANS LA PRODUCTION D'EAU LOURDE PAR LE PROCEDE H_2S. (Examination of Recent Improvements Proposed by the Americans in Heavy Water Production by the H_2S Process). M. Rostaing (Spain. Junta de Energia Nuclear, Madrid and European Atomic Energy Society, Paris).

Improvements that would permit the production of heavy water by isotopic exchange between H_2S and water for $17/lb were announced. After comparison of plants with and without the improvements and consideration of European economic conditions, most of the improvements were approved for European use. It was estimated that a European plant embodying the improvements could produce 200 ton/yr for $19/lb. (D.C.W.)

18258 (NP-13766(p.27-36)) OBTENTION D'EAU LOURDE EN ESPAGNE. DESCRIPTION DE L'USINE JEN-EIA DE SABINANIGO. (Heavy Water Production in Spain. Description of the JEN-EIA Plant at Sabinanigo). M. Gispert Benach (Spain. Junta de Energia Nuclear, Madrid and European Atomic Energy Society, Paris).

The Sabinanigo plant in which heavy water is recovered from hydrogen obtained by electrolysis is described. Specific processes and systems are discussed. (D.C.W.)

18259 (NP-13766(p.37-52)) A THEORETICAL STUDY ON THE UTILIZATION OF GAS SCRUBBERS IN A CASCADE OF ELECTROLYSERS AND ISOTOPIC EXCHANGE. J. L. Otero de la Gandara and A. María Arcocha (Spain. Junta de Energia Nuclear, Madrid and European Atomic Energy Society, Paris).

Isotopic exchange cascades in which heavy water is recovered from hydrogen obtained by electrolysis were studied. The effects of steam on the hydrogen and oxygen condensers was considered. Specifically, the yield improvement resulting from scrubbing the gases leaving the condensers with the feed water of the cascade stage from which they proceed was calculated. (D.C.W.)

18260 (NP-13766(p.53-76)) A STUDY OF THE OPTIMUM HANDLING PROCEDURES OF A CASCADE OF ELECTROLYSERS AND ISOTOPIC EXCHANGE REACTORS BY MEANS OF AN ELECTRONIC COMPUTER. J. L. Otero de la Gandara and A. Maria Arcocha (Spain. Junta de Energia Nuclear, Madrid and European Atomic Energy Society, Paris).

Computer programs were developed to establish the optimum handling procedures for the Sabinanigo heavy water plant. The best grouping of the electrolyzers from a power distribution standpoint was determined, and modifications in operation due to steam demand variations were studied. The stability of the contemplated cascade was investigated, as well as variations due to electric charge fluctuations in the electrolyzers. Yield variations due to power decreases were also determined. (D.C.W.)

18261 (NP-13766(p.77-83)) FINAL- AND RECONCENTRATION OF HEAVY WATER BY MEANS OF KUHN-SULZER COLUMNS. Max Thurkauf (Spain. Junta de Energia Nuclear, Madrid and European Atomic Energy Society, Paris).

The high-efficiency Kuhn-Sulzer heavy water distillation column for concentration of heavy water is described. The feed rate of the column is 500 cm^3/hr, and a photoelectric system checking the concentration of the produced heavy water maintains concentration between 99.85 and 99.90%. Compactness and flexibility are among the attributes of the column. The functioning of the column is explained. (D.C.W.)

18262 THE PRESENT STATE AND THE PROBLEMS OF HEAVY WATER MANUFACTURING. Yasuo Kurihara. Genshiryoku Kogyo, 9: No. 8, 57-62(Aug. 1963). (In Japanese)

Heavy-water manufacturing processes, which have been used on the industrial scale or which have economical possibilities, are reviewed. Special attention is devoted to the stage of development in Japan. Six processes are described: (1) Electrolysis without recycle with which 20 to 40 kg/yr of heavy water have been produced in Japan. The technical problems of this process have been completely settled, although it is fairly expensive for use in large scale production. (2) Exchange reaction process, which must be combined with electrolysis for use on an industrial scale. (3) Dual-temperature exchange process: (a) H_2S–HDO exchange, in which the problems are a suitable heat exchanger and corrosion of the apparatus by H_2S; (b) H_2O–H_2 exchange, which is still in the development stage with the problem of getting a stable liquid catalyzer of high

activity; and (c) NH_3-H_2 exchange, which is industrially favorable, but still in the research stage in Japan. (4) Liquid H distillation process, which should be economically favorable as an industrial process, if problems in low temperature were solved. (5) Water distillation process, which is usable as a middle-stage concentrating method and for which satisfactory technical procedures are established in Japan. (6) Electrolysis with recycle cascade, technical problems of which as a method of gas collection from a 1000 amp electrolysis cell have been settled. (from NSA of Japan)

18263 IODINE-125 PRODUCTION. Isotopes Radiation Technol., 1: No. 2, 143-6(Winter 1963-64).

The preparation of ^{125}I and its fabrication into radiographic sources are reviewed. A number of batch production runs for preparation of ^{125}I by irradiation of ^{124}Xe were made with targets of natural xenon under pressure. Unit full-recovery cost of 2-C batches containing <15% ^{126}I was ~$1.00 per mC. It was estimated that increased pressure and container size could reduce the cost to < $0.10 per mC, and, with a circulating pressurized loop and enriched ^{124}Xe, the cost could be further reduced to <$0.50 per mC. ^{125}I may also be produced in the cyclotron by the nuclear reactions $^{125}Te(p,n)^{125}I$, $^{125}Te(d,n)^{125}I$, and $^{125}Te(d,2n)^{125}I$. The product, however, is very expensive and highly contaminated with other iodine isotopes. (M.C.G.)

18264 CALCIUM-47 PRODUCTION AT ORNL. Isotopes Radiation Technol., 1: No. 2, 146-9(Winter 1963-64).

The method by which ^{47}Ca is produced at ORNL is described, together with a history of its production and other possible reactions for making it. The isotope is produced by the $^{46}Ca(n,\gamma)^{47}Ca$ reaction in a high-flux reactor from target material electromagnetically enriched in ^{46}Ca. The product, which sells for $200 per mC, has a $^{47}Ca/^{46}Ca$ ratio of >20:1 and is made at a rate of 25 mC per month. In addition to the $^{46}Ca(n,\gamma)^{47}Ca$ reaction, ^{47}Ca can be produced in the cyclotron by bombardment of ^{46}Ca or by transmutation of ^{50}Ti by $(\alpha,p\alpha)$ or (n,α) reactions. (M.C.G.)

18265 STABLE ISOTOPES. Isotopes Radiation Technol., 1: No. 2, 149-52(Winter 1963-64).

The preparation of enriched stable isotopes from fission products is discussed. The expected theoretical abundances of stable fission-product isotopes in two-year-old wastes from processing of fissioned uranium are shown in tabular form. (M.C.G.)

18266 FUNDAMENTAL STUDIES ON THE ION EXCHANGE SEPARATION OF ISOTOPES. VIII. CONTINUOUS ENRICHMENT OF LITHIUM ISOTOPES BY A SIMULTANEOUS USE OF ION EXCHANGE AND ELECTROMIGRATION. Hidetake Kakihana (Tokyo Inst. of Tech.), Yoshihiro Mori, and Tadaya Hoshino. Nippon Genshiryoku Gakkaishi, 6: 65-71(Feb. 1964). (In Japanese)

A new type of apparatus for isotope separation was devised on the basis of simultaneous use of ion exchange and electromigration for a continuous isotope enrichment. To examine the efficiency of this apparatus, experiments on lithium isotope separation were carried out. At the stationary state of continuous operation, the separation factors of Li_2CO_3 system and LiOH system were found to be 1.0069 and 1.0049, respectively. Apart from the advantage of continuous operation, these values are larger than that of 1.001 obtained with Diaion SK #1-LiCl system, 1.002 with Dowex 50X-8-LiCl system, and 1.0038 obtained by the electromigration in $LiNO_3$ aqueous solution, while smaller than 1.008 obtained by the electromigration in ion exchange membrane. (P.C.H.)

18267 ASTON BANDS IN THE ELECTROMAGNETIC MASS SEPARATOR. B. Čobić, D. Tošić, and B. Perović (Inst. of Nuclear Sciences, Belgrad). Nucl. Instr. Methods, 25: 157-61(Dec. 1963).

The appearance of Aston bands in the electromagnetic mass separator was investigated. The apparent masses were identified by recording the mass spectra of different elements: Ar, Ti, Mo, Ag, Sb, W. The ion beams were obtained by magnetron ion source in the sector type mass separator ($\varphi = 60°$, $V_i = 30$ kv, $r = 75$ cm). It was found that in the running conditions of the mass separator, Aston bands resulted from the charge exchange (30/21), (30/12), (20/11) and the stripping processes (10/21). The effect of these processes on the separation of isotopes is discussed. (auth)

18268 PROCESS OF ISOTOPE SEPARATION BY COUNTER-CURRENT ELECTROMIGRATION IN FUSED SALTS. Marine Salomon Chemla (to Commissariat à l'Energie Atomique). U. S. Patent 3,127,336. Mar. 31, 1964. Priority date Nov. 24, 1958, France.

A process and an electrolytic cell are described for separating lithium isotopes by countercurrent electromigration in fused bromides. In the process, the melting point of LiBr is lowered to 150°C by the addition of 30% KBr, in order to reduce the problems attendant to operation at high temperatures, and liquid bromine is circulated in closed circuit. The operation of the cell is shown to result in the LiBr/KBr ratio decreasing from 2.0 to 1.1 in the first 12 days and remaining steady thereafter, and in the $^7Li/^6Li$ ratio increasing from 11.7 to 22.4 in 30 days. (D.L.C.)

MATHEMATICS AND COMPUTERS

Refer also to abstract 17721.

18269 (BNL-7852) A DIGITAL DATA HANDLING SYSTEM FOR HIGH-ENERGY PHYSICS EXPERIMENTS. David Potter (Brookhaven National Lab., Upton, N. Y.). Feb. 6, 1964. Contract AT-30-2-GEN-16. 66p.

See CAPE-1127 for drawings.

The digital data handler stores bits describing selected nuclear events during the burst of a pulsed particle accelerator. During the accelerator dead-time, which is at least ten times longer than the burst time, the digital information describing the stored events is read out and written on magnetic tape and simultaneously transmitted to a digital computer. The information on tape becomes the permanent record of the experiment, while the computer samples events, performs calculations and error analysis, and provides the experimenter with on-the-spot displays. Typically, a printout with desirable tabulations, plots, error analysis, etc. is provided at the end of each run when enough events are analyzed for good statistics. The components of the system and their operation are described. (auth)

18270 (EUR-282.f(Add.)) APPROXIMATION DES FONCTIONS DE BESSEL—OPTIMISATION DES PROGRAMMES CORRESPONDANTS. (Approximation of BESSEL Functions—Optimization of Corresponding Programs). R.-F. Gloden (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy and European Atomic Energy Community. European Scientific Data Processing Center, Ispra, Italy). 1964. 14p.

Subroutines were developed for calculating Bessel functions in double precision with an error $<10^{-12}$. The number of locations used is always <5000, and the average calculation times for one value of the variable are between 9 and 15 msec. The calculational procedures and the routines are briefly described. (auth)

18271 (JINR-P-1549) ANALITICHNOST RESHENIYA KRAEVOI ZADACHI DIFFERENTSIAL'NOGO URAVNENIYA VTOROGO PORYADKA V SINGULYARNOI TOCHKE. (An Analytic Solution of the Boundary Value Problem for a Second-Order Differential Equation at a Singularity). I. V. Puzynin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1964. 12p.

It is proved that the solutions of a boundary value problem for a nonlinear differential equation of the second order are analytic in the vicinity of a singularity. This property is necessary to construct some algorithms for a numerical solution of the boundary value problem which is encounted in nuclear theory and in the nonlinear field theory when the elementary particle interaction is studied. (auth)

18272 (TID-20380) TECHNICAL PROGRESS REPORT. PART I. HIGH-SPEED COMPUTER PROGRAM. PART II. ILLIAC II SYSTEM PROGRAMMING, MAINTENANCE AND OPERATION. PART III. CIRCUIT RESEARCH PROGRAM. PART IV. IBM 7094-1401 SYSTEM. PART V. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). Jan. 1964. Contract AT(11-1)-415. 48p.

Experiments on a possible monostable amplifier indicated a minimum output pulse width of 900 μa/sec and a maximum repetition rate of 380 Mc. The circuit can be triggered on either a positive or negative differential of the input pulse. Research on active networks indicates that a buffer amplifier consisting of two coupled transmission lines, one of which contains a tunnel diode, can replace a gyrator. Further research on light coupling of light emitter diodes (GaAs) and photodiodes showed that the coupling ratio (photodiode current/emitter diode current) was greatly improved by going to liquid nitrogen temperature. A rise time of 1 nsec now appears possible with current amplifiers having a gain of about 1000. Thirty-five problem specifications (described) were submitted to the IBM 7094. ILLIAC II operation and programming, IBM 1401-7094 operation and reliability, and component development and testing in the high speed computer program are summarized. (D.C.W.)

18273 (WAPD-TM-346) BAFL-2—A PROGRAM TO SOLVE BIHARMONIC TYPE EQUATIONS ON THE PHILCO-2000 COMPUTER. A. K. Rigler (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Jan. 1964. Contract AT-11-1-GEN-14. 55p.

The program BAFL-2 approximates the solution of the equation $\nabla^4 w = f(x,y)$ in a polygonal region using the method of finite differences. The boundary value problem is developed, and the derivation of the finite difference equations is illustrated. The solution is also described, as are the restrictions imposed by the program and the preparation of input. Two sample problems illustrate the input preparation and the output format. (D.C.W.)

18274 (ZFK-WF-7) PROGRAMMSTEUERUNG AUF RELAISBASIS ZUR AUTOMATISIERUNG PHYSIKALISCHER EXPERIMENTE. (Program Control for Basic Relays for Automation of Physical Experiments). H. Hoefgen (Germany. Zentralinstitut für Kernphysik, Dresden). Nov. 1960. 37p.

Groups of relays are described that are of general interest in the automatic performance of physical experiments. The possibilities of the modulation of signals with and without temporal retardation are explained. Several examples of the realization of control tasks are given. (auth)

18275 A STORED PROGRAM COMPUTER AS A MULTIPARAMETER RADIATION ANALYZER. J. V. Kane (Bell Telephone Labs., Inc., Murray Hill, N. J.) and R. J. Spinrad. Nucl. Instr. Methods, 25: 141-8(Dec. 1963).

The use of a stored program computer as a multichannel radiation analyzer is described. Some of the advantages claimed for this method are: great flexibility of function at reasonable cost; an unlimited number of memory locations available for data recording purposes when used with a magnetic tape transport; several cathode ray tube displays of large bodies of data easily available; data transformations and data reduction operations may be performed by this same device; and ability to perform simultaneous input, output, and internal operations during the typical nuclear physics counter experiment. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General

Refer also to abstract 17977.

18276 (AD-431996) THE STRESS-STRAIN BEHAVIOR OF STRONTIUM ZIRCONATE. Bimonthly Progress Report No. 2, November 15, 1963–January 15, 1964. J. E. Funk, J. Nemeth, and J. R. Tinklepaugh (New York. State Univ. Coll. of Ceramics, Alfred). Contract NOw-64-0051-d. 20p.

The crystal structure of strontium zirconate might provide a clue to the understanding of the stress-strain behavior of the material and for that reason considerable time was expended in careful x-ray analysis. Efforts to sinter strontium zirconate were not successful. The reasons for this are being investigated. Efforts to grow single crystals of strontium zirconate by precipitation from low melting salts are continuing. (auth)

18277 (AD-432420) DISPERSION STRENGTHENED NICKEL-BASE ALLOYS. Final Report, March 1–December 31, 1963. A. S. Bufferd, R. C. Nelson, and N. J. Grant (New England Materials Lab., Inc., Medford, Mass.). Feb. 24, 1964. Contract N600(19)-59891. 24p.

The dispersion strengthening of nickel-chromium alloy and Udimet-500 modified compositions was investigated with thorium oxide introduced by mechanical mixing or thermal decomposition techniques. Thermal decomposition of thorium nitrate onto the nickel-20 wt % chromium alloy powder produced a better degree of thorium oxide dispersion than mechanical mixing. The 100 hr rupture life stress of nickel-chromium alloy at 1800°F was increased from 1600 to 3400 psi with the addition of 5 vol % thoria. In addition, the effect of further cold deformation after extrusion on properties was investigated with 2.5 and 5 vol % thoria dispersions in nickel-chromium alloy. (auth)

18278 (AD-433095) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. Mary F. Banks, comp. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Feb. 1964. 63p.

A total of 98 references in abstracted form is presented of selected documents and journal articles on subjects within the technical scope of DMIC. The references are arranged under the headings: high-strength alloys, light metals, nonmetallics, refractory metals, and miscellaneous. Author, subject, and DMIC numerical indexes are included. (D.L.C.)

18279 (AGN-8041(Del.)) OPERATION OF 1850°F PUMPED BOILING CESIUM LOOP SYSTEM AND DETERMINATION OF SPECIFIC HEAT, DENSITY, AND VAPOR PRESSURE OF CESIUM BETWEEN 174 AND 1800°F. Final Report on CESIUM CORROSION AND THERMO-PHYSICAL PROPERTIES EVALUATION PROGRAM. [Period Covered] January 30, 1961–February 15, 1962. Peter F. Young (Aerojet-General Nucleonics, San Ramon, Calif.). Contract AT(04-3)-368. 78p.

A pumped, boiling cesium Nb-1 Zr contained loop was operated for 2014 hours at a boiling temperature of 1850°F, a subcooled temperature of 700°F, a flow rate of 0.84 gpm, and a vapor quality of 10 ± 3%. Flow conditions selected for the loop operation approximate some of the state point and flow conditions of a high temperature Rankine cycle space power plant. The purpose of the cesium loop was to determine the corrosion and mass transfer effects of cesium on containment materials and to gain information on instrumentation and control problems of pumped, boiling alkali metal loops. Test equipment was designed, built, and operated to permit direct measurement of the following properties of cesium over the temperature range 1000 to 1800°F: (1) density, (2) vapor pressure, and (3) specific heat. Using these measurements, the properties of (1) enthalpy, (2) entropy, (3) vapor specific volume, and (4) latent heat of vaporization were calculated. (auth)

18280 (ANL-6792(p.297-313)) STATUS OF THE URANIUM–PLUTONIUM CARBIDE FUEL DEVELOPMENT PROGRAM. A. A. Strasser (United Nuclear Corp. Development Div., White Plains, N. Y.).

A summary is given of attempts to develop a fabrication technique, measure the out-of-pile properties, and study the irradiation behavior of uranium–plutonium carbide fuel. (C.E.S.)

18281 (BM-RI-6403) URANIUM ALLOYED STEELS; THEIR FABRICATION AND MECHANICAL PROPERTIES. Leo W. Higley, Jr., and K. A. Fowler (Bureau of Mines. Rolla Metallurgy Research Center, Mo.). June 1963. 18p.

Steels with an alloying addition of depleted uranium were studied to develop successful melting, casting, and fabricating methods; to obtain data on mechanical properties; and to determine the effects of this alloying element. Uranium in amounts up to 1.5 percent was added to steel-base compositions containing approximately 0.5 percent carbon, 2 percent nickel, 0.25 to 2.0 percent silicon, and 0.75 percent manganese in both vaccum-melted and air-melted heats. Radiation levels were monitored for all operations. Research showed that uranium additions did not increase tensile strength; that hot-shortness occurred during forging above 1090°C because of the presence of a low melting point constituent of a eutectic type; and although a measurable amount of radioactive contamination resulted from processing, the quantity was never large enough to require the work area to be identified as a radiation area. (auth)

18282 (BNL-844) HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW. A Bimonthly Technical Progress Review. Volume 1, No. 6. (Brookhaven National Lab., Upton, N. Y.). Dec. 1963. Contract AT-30-2-GEN-16. 72p.

Information is included on: sodium-heated steam generator development; thermodynamic properties of K and Nb–Zr alloy; engineering properties of K and Cs; research on cavitation and cavitation damage in liquid metals, Hg and H_2O, and mechanical pump impellers operating in liquid metal space power loops; sodium pumps and loops; 15 kw solar mechanical engine; sodium cold traps; reactor development; liquid metals technology of Hg, K, Na, NaK, Rb, and Cs; liquid metal heat and mass transfer; heat rejection problems in nuclear space power plants; SPUR program; effects of high temperature Na on austenitic and ferritic steels; structural materials in LASL liquid sodium systems; LAMPRE program; two-stage potassium test turbine; and application of nuclear electrical power to manned orbiting space stations. (P.C.H.)

18283 (CNLM-4092) REFRACTORY METALS AS ALKALI LIQUID METAL CONTAINMENT MATERIALS. R. E. Cleary (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). [1962]. Contract AT(30-1)-2789. 15p. (CONF-459-1)

From Golden Gate Metals Conference, San Francisco, Feb. 1962.

Refractory metals and their alloys are good container materials for alkali metal coolants. Thermodynamics of interaction with contaminants have been correlated with experimental tests and show the need for high purity materials. Structural metal solubility data to 1600°F can be used to correlate and predict engineering systems. (auth)

18284 (CONF-187-36) THE FACTORS LIMITING THE UTILIZATION OF ZIRCONIUM ALLOYS IN SUPERHEATED STEAM. H. H. Klepfer and D. L. Douglass (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Nov. 20, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 44p.

From American Nuclear Society Meeting, New York, Nov. 1963.

New experimental data and literature data are utilized to determine the upper temperature of usefulness of zirconium alloys. Three basic engineering assumptions are used: (1) service life requirements are on the order of four years; (2) tubular fuel cladding for rod-type fuel is considered with a maximum wall thickness of 1.27 cm; and (3) heat fluxes are above 157 watts/cm^2. The interrelation of three basic factors, corrosion rate, corrosion embrittlement by hydrogen and oxygen, and strength are considered. An upper limit for an acceptable corrosion rate for a long-term service of 1 mg/dm^2/day is set primarily by the effect of heat-transfer on corrosion. For the best alloys anticipated, this requirement (even without considering transient conditions) limits cladding surface temperatures to less than 540°C. Oxygen embrittlement of the alloy substrate by oxide film dissolution is not expected to be a limiting factor. Corrosion hydrogen embrittlement was studied in detail and found to limit acceptable service to cladding surface temperatures of less than 525°C for established experimental alloys. Hydrogen embrittlement may not be a limiting factor if alloys corrosion resistant enough to be acceptable above 600°C could be developed. Zirconium alloys designed for higher strength to overcome their inherent rapid loss of creep strength at temperatures above 540°C are expected to be more susceptible to corrosion hydrogen embrittlement. The results of this study indicate that there is good promise for developing zirconium alloys for fuel cladding application at temperatures up to 475°C. (auth)

18285 (DP-803(Del.)) HYDRIDING OF ZIRCALOY-2. A Literature Search. Myra S. Feldman (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). May 1963. Contract AT(07-2)-1. 78p.

Abstracts are given of the literature on the hydriding of Zircaloy-2 for the period from 1955 through June 1962. The abstracts are arranged under the headings hydrogen pickup during corrosion, and effects of additives, hydriding of Zircaloy under irradiation, chemical and physical properties, mechanical properties, and general references. (D.L.C.)

18286 (EURAEC-966) INFLUENCE OF NITROGEN IN IRON AND STEEL UNDER FAST NEUTRON IRRADIATION. Quarterly Report No. 1, October 1–December 31, 1963. F. Rossi (Società Richerche Impianti Nucleari, Centro Richerche Nucleari, Sluggia, Italy). Jan. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 004-63-10-TEEI(RD). 12p.

A program for studying the behavior of nitrogen and carbon present in iron and their different influence on the brittleness and other mechanical properties is discussed. Different grain sizes are to be obtained by different cold rolling reduction of area before thermal treatment. Total nitrogen content in iron is to be determined by the Kjeldal method of acid extraction as ammonia, steam distillation, and spectrophotometric determination with Nessler reagent. Equipment for internal friction measurements is set up. Techniques for measuring magnetic properties are discussed. (N.W.R.)

18287 (HW-80806) COMPUTER PROCESSING OF URANIUM FEEDSITE DATA. William Bowie and G. L. Hammons (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 14, 1964. Contract AT(45-1)-1350. 14p.

The FEM system stores uranium feedsite data from punched cards on magnetic tape for future analysis. At this time, data characterizing over 75 variables are available on eight secret cards for each ingot produced. The system allows retrieval of these data by three methods, i.e. (1) a summary program which gives a distribution, the averages, and the standard deviations, (2) a printout of any data, and (3) punched cards. The cost of maintaining the FEM system and summarizing certain routine variables monthly, is estimated to be less than $1000 per year. (auth)

18288 (HW-SA-2701) IMPROVED FISSION PRODUCT GAS COLLECTION EQUIPMENT. C. G. McCormick (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 31, 1962. Contract AT(45-1)-1350. 13p.

Fission product gas is collected from oxide fuel elements of a wide variety of sizes and shapes at Hanford. An element is opened by drilling through a vacuum seal against the element wall, established by compressing it between exchangeable, custom designed holding blocks, one of which is faced with neoprene. The drill rod is sealed with a triple quad-ring seal, lubricated with vacuum grease. Gas samples exhaust through a 25 μ stainless steel filter, trapping particulate matter in the cell, and are pumped into glass sample bulbs by a stainless steel Toepler pump. Analysis is by mass spectrometry. (auth)

18289 (LADC-6023) THE RECOVERY OF MECHANICALLY ENTRAPPED PLUTONIUM FROM CASTING SKULLS AND TURNINGS. D. R. Harbur, J. W. Romero, and J. W. Anderson (Los Alamos Scientific Lab., N. Mex.). Nov. 22, 1963. Contract W-7405-eng-36. 24p. (CONF-450-1)

For Presentation at American Foundrymen's Society Meeting, Atlantic City, Apr.-May 1964.

The small critical mass of plutonium which limits charge size, coupled with its value necessitating quantitative recovery from all residues, makes the direct recovery of mechanically entrapped plutonium from casting skulls and oxidized turnings an economic necessity. The newest method used at the Los Alamos Scientific Laboratory for the direct recovery of entrapped plutonium involves mechanical stirring and vibration of the plutonium melt to physically break up to spongy skull and oxide film, thus allowing the heavier molten plutonium to settle

out at the bottom of the melt. The recovery equipment and procedures are described. (auth)

18290 (LAMS-3054) QUARTERLY STATUS REPORT ON SOLID PLUTONIUM FUELS PROGRAM FOR PERIOD OCTOBER 1 THROUGH DECEMBER 31, 1963. J. A. Leary, W. J. Maraman, W. N. Miner, and F. W. Schonfeld (Los Alamos Scientific Lab., N. Mex.). Mar. 1964. Contract W-7405-eng-36. 13p.

A pellet of PuO_2 was held for 3 hr at 1650°C in a vacuum of 10^{-5} torr and then quenched as rapidly as possible by contacting with a chilled copper block. The microstructure of the polished pellet showed only the $\alpha-Pu_2O_3$ and PuO_2 network structure, with no PuO_2 matrix. Nitride is being prepared by reaction of Pu metal and N_2, with and without the use of H_2. Thermal conductivities of UC, $PuC_{0.87}$, $(U_{0.9}Pu_{0.1})C$, $(U_{0.8}Pu_{0.2})C$, and $(U_{0.7}Pu_{0.3})C$ and electric resistivities of $(U_{0.8}Pu_{0.2})C$, $PuC_{0.87}$, and $PuC_{1.0}$ were determined and plotted. The thermodynamic properties of Pu–Fe alloys and $PuFe_2$ are being determined by emf measurements. Studies are being made of the Pu–C–O system in order to determine the phase diagram. (M.C.G.)

18291 (LAMS-3057) QUARTERLY STATUS REPORT ON PLUTONIUM REACTOR FUEL DEVELOPMENT FOR PERIOD ENDING FEBRUARY 20, 1964. (Los Alamos Scientific Lab., N. Mex.). Mar. 1964. Contract W-7405-eng-36. 14p.

A reappraisal of problem areas in the molten plutonium fuels program led to a decision to postpone indefinitely the planned reloading of the LAMPRE core. Fifty-four Pu–Fe fuel capsules were removed from the core and replaced by a Ta-tipped stainless steel dummy. A facility for making gamma scans of LAMPRE capsules and similar sources is nearly ready for use. Apparatus is being developed for use in testing LAMPRE-like capsules under severe conditions. All capsules being removed from the LAMPRE Core II are being subjected to examination involving the following operations: puncturing for gas determination, sectioning at the weld to look for the presence of intergranular penetration and platelets, sectioning at the fuel level to investigate the possibilities of wall thinning, and sectioning below the fuel level to determine the presence of solution or intergranular penetration. The joining of a plug to a tube by magnetic swaging followed by either welding or diffusion bonding and the joining of tubing by percussion or projection welding are being examined further. The reaction layer between Pu–Co–Ce alloy and Ta cladding was investigated and phase studies were carried out on the Pu–Co–Ce alloy. Shop drawings and equipment submittals for the Core Test Facility are being received. Liquidus temperatures for 4 Pu–Fe alloys were determined by differential thermal analysis. The solubility limits of Sc in δ–Pu were determined. (M.C.G.)

18292 (N63-20341) PROCESSING AND EVALUATION OF PRE-PRODUCTION QUANTITIES OF COLUMBIUM ALLOY SHEET. Final Report, January 24, 1963–January 15, 1964. R. A. Nadler (Westinghouse Electric Corp. Materials Mfg. Div., Blairsville, Penna.). Jan. 20, 1964. Contract N600(19)-59546. 64p.

Single 300-lb, 6-in. dia ingots of FS-85 (Nb-27Ta-10W-1Zr) and B-66 (Nb-5Mo-5V-1Zr) were converted to 0.050 in. by 18 in. wide sheet and evaluated with respect to mechanical properties and weldability. The yields from ingot to sheet were 46% for B-66 and 50% for FS-85. FS-85 was judged to be the more fabricable alloy and this was attributed to its lower strength. The quality of the sheet produced was equivalent for the two alloys except that better flatness was achieved for FS-85. The tensile strength and stress-rupture behavior of B-66 was superior to that of FS-85 up to 2400°F. This superiority is greatly magnified when comparisons are made on a strength: density basis, as FS-85 is 25% more dense than B-66. Base metal bendability was less than 1T for both alloys. FS-85 had a 4T bend transition temperature of –250°F as compared to –100°F for B-66. The as-welded ductility of FS-85 was superior to that of B-66, although welds of the latter alloy had good ductility at room temperature for the high strengths exhibited by the alloy. Despite differences in base metal transition temperature, both alloys had a weld metal transition temperature of 50°F. Post-weld anneals reduced the bend transition temperature of FS-85 to 0 to –100°F, but progressively raised the transition temperature for B-66, apparently as a consequence of aging during annealing. (auth)

18293 (NMI-2125) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report to United States Atomic Energy Commission for the Month of January 1964. (Nuclear Metals, Inc., West Concord, Mass.). Mar. 27, 1964. Contract AT(30-1)-2784. 62p.

Progress on the fabrication of tungsten and W-Re tubing by extrusion and evaluation of the mechanical properties and recrystallization behavior of W–Re tubing is reported. Work in the preparation of beryllium single crystals by zone refining double-distilled beryllium is summarized. Properties of U-0.2 wt % Be and Zircaloy-2–1.4 wt % Be alloy systems are discussed. (M.C.G.)

18294 (NP-13758) INVESTIGATION OF PRACTICAL TECHNIQUES FOR COATING REFRACTORY METALS. Quarterly Progress Report No. 1, May 1, 1963 to July 31, 1963. J. Zupan, E. G. Pike, and J. B. Whitney (Pfaudler Co., Rochester, N. Y.). Aug. 15, 1963. Contract AF33 (657)-8920. 17p.

Studies are being continued to develop practical techniques for applying protective coatings to refractory metal alloys. The D-14 alloy (Nb-5Zr) currently being used as the substrate will be replaced early in the program with D-43 (Nb-10W-1Zr). Initial experiments were made to establish the feasibility of fused salt bath deposition as a continuous process. Experimental work under way on the fluidized bed process was concerned with the evaluation of the fluidizing characteristics of various silicon–alumina mixtures. The furnace and its controls for the 8-in. dia fluidized bed were received and are being installed. Electrokinetic and rheological studies of particles are being continued to obtain basic data for use in the design of slurry process systems. Current efforts are the investigation of water stabilizers and bisque strengtheners. (auth)

18295 (SC-DR-281-63) FILM DEPOSITION USING ACCELERATED IONS. D. M. Mattox (Sandia Lab., Albuquerque, N. Mex.). Nov. 1963. Contract AT(29-1)-789. 17p.

A technique called "Ion Plating" is described which allows the formation of adherent films or coatings on metallic, semiconducting, or insulating substrates. The essential feature of the process is the ionization and acceleration of the depositing species by a gaseous discharge. The adherence of the deposits formed in this manner is excellent, even in those cases where conventional evaporation or electrodeposition techniques fail to provide adherent films. A discussion is given of the types of interfacial regions that may be formed during the film deposition and their influence on the adherence of the deposit. (auth)

18296 (ZFK-WF-6) DIE EINWIRKUNG ENERGIEREICHER IONEN AUF METALLOBERFLÄCHEN. (The Effects of Energetic Ions on Metal Surfaces). M. Balarin and F. Hilbert (Germany. Zentralinstitut für Kernphysik, Dresden). Nov. 1960. 23p.

The investigation of a metallic surface, strongly sputtered with high-energy ions, shows that the sputtering of atoms can be understood only by a collision mechanism, but not by means of evaporation theory. It was proposed for an approximate mathematical treatment that the maximum impulse, transferred to an atom moving parallel to the surface as a result of a single collision process, is a measure of the probability for the ejection of atoms out of the lattice. In accordance with the experiment, the existence of an angle of incidence between 45 and 90° for the greatest sputtering yield can be shown. The samples were investigated by light and electron microscopy. The furrows on the Cu-surface due to the bombardment with a monoenergetic, obliquely incident, parallel ion beam, show that the lattice ions were ejected preferentially in the forward direction. A relation between the observed clods and furrows and the close-packed lattice planes was investigated. (auth)

18297 (EURAEC-917) DEVELOPMENT OF PROCESSES FOR THE PREPARATION OF URANIUM CARBIDES AND CERMETS ON UC-BASIS. Quarterly Report No. 14, October 1–December 31, 1963. (Nuklear-Chemie und-Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). Work Performed under United States–Euratom Joint Research and Development Program. Contract 088-62-7 RDD. 25p. (A translation)

Uranium carbides were melted and cast in a centrifugal furnace in an atmosphere of argon under a pressure of 100 to 150 torr. Analyses concerning the carbon and nitrogen contents of all UC samples, as well as of the skull, were made and ground slides were prepared. Within the range comprised between 3 and 4.8% by weight of carbon, the average grain coarseness increases with increasing carbon content. Heat conductivity measurements were carried out on UC samples with various carbon contents. Whereas, in long-time corrosion tests in a moist atmosphere, differences in weight were already noticeable after a short time, no early corrosion could be detected in dry argon. A determination was made of the impact required for breaking into two parts UC rods of 15.5 mm in dia. (auth)

18298 TRENDS OF THE EVOLUTION OF CERAMIC PRODUCTS. Pol Paquin. Bull. Soc. Franc. Ceram., No. 57, Suppl., 55p. (Oct.-Dec. 1962). (In French)

The history of the evolution of ceramic products is discussed, and the rapid development of ceramic products and their use in various branches of ferrous metallurgy, electrotechniques, electronics, nuclear energy and astronautics are reviewed. Topics discussed are: dielectric ceramic, insulating, and piezoelectric products, and ferrites; pure oxide refractory products obtained by sintering; carbides, nitrides, silicides, and borides; sulfides and fluorides; graphites; and cermets, whiskers, composite materials, and ceramic linings on a plasma torch support. The consequences of irradiation of ceramic products are mentioned. 200 references are included. (P.C.H.)

18299 USE OF NEUTRONS IN THE MEASUREMENT OF MOISTURE CONTENT IN RAW MIXTURE FOR SINTER. Keiji Tsujihata (Yawata Iron and Steel Co., Ltd., Japan) and Tetsuo Sumi. Hitachi Hyoron, 45: No. 7, 47-52(July 1963). (In Japanese)

A method for continuously analyzing the moisture content of iron-ore sintering mixtures is described. The neutron-slowing-down power of the sintering material is measured, since this corresponds to its moisture content. An accuracy of ±0.5% was obtained with material having a moisture content of 8 to 10% and a constant bulk density. The same accuracy was obtained using the method in a production facility. Automatic control of moisture content would be possible with this method and a computer. (from NSA of Japan)

18300 CALCINATION OF BeO FROM BASIC ACETATE-DERIVED $Be(OH)_2$. Robert C. Rau (General Electric Co., Cincinnati). J. Am. Ceram. Soc., 47: 179-84(Apr. 21, 1964).

X-ray diffraction, electron microscopy, and infrared spectroscopy were used to study the changes in BeO powders produced by the calcination of basic acetate-derived $Be(OH)_2$. Weight loss, hydroxyl ion content, particle configuration, and crystallite growth were observed as a function of increasing calcination temperature. Low-temperature calcining (<360°C) yielded a BeO product that showed incomplete weight loss, very small crystallite size, and appreciable water content. Calcining at high temperatures (>375°C) formed BeO showing the theoretically predictable weight loss and very little water present. The size of the beryllia crystallites increased with increasing calcination temperature, but the size and shape of the particles remained constant. Basal-plane stacking faults were observed in the calcined BeO. (auth)

18301 LOW-TEMPERATURE SINTERING OF PURE TUNGSTEN AND TUNGSTEN–IRIDIUM. H. W. Hayden and J. H. Brophy (Massachusetts Inst. of Tech., Cambridge). J. Less-Common Metals, 6: 214-18(Mar. 1964).

Commercially pure tungsten powder sinters by a grain boundary diffusion process in the temperature range 1050 to 1200°C. The apparent activation energy for this process is 90,000 cal/mole. Small additions of Group VIII elements normally accelerate the interfacial transport process. Iridium, however, actually retards densification by the interfacial path with the result that volume self-diffusion of tungsten possibly dominates the slower densification rate. For this process the apparent activation energy is 133,000 cal/mole. (auth)

18302 PREPARATION, PROPERTIES, AND APPLICATION OF METAL/CERAMIC MIXTURES. A. G. Thomas, J. B. Huffadine, and N. C. Moore (Plessey Co. Ltd., Towcester, Northants, Eng.). Met. Rev., 8: 461-88(1963).

A review is presented on the preparation, properties, and application of cermets. Theoretical aspects, fabrication processes, properties, cermet types, and present status and future prospects are discussed. 150 references are included. (P.C.H.)

18303 REACTOR MATERIALS. Volume 7, Number 1. R. W. Dayton, E. M. Simons, and R. W. Endebrock (Battelle Memorial Inst., Columbus, Ohio). Spring 1964. $0.70 (GPO) (Domestic), $0.90(GPO) (Foreign). (One of the Technical Progress Reviews prepared quarterly for the Division of Technical Information, USAEC). 83p.

Properties, behavior, and fabrication processes of materials applicable to nuclear reactor components and associated equipment are reviewed. Separate abstracts were prepared for each of the 5 sections (fuel and fertile materials, moderator materials, nuclear poisons, cladding and structural materials, and special fabrication techniques) and for the feature article on stress corrosion of austenitic stainless steels in reactor systems. (M.C.G.)

For abstracts of individual items see: 18304, 18305, 18306, 18307, 18326, and 18338.

18304 FUEL AND FERTILE MATERIALS. Reactor Mater., 7: No. 1, 14-35(Spring 1964).

Research on unalloyed uranium, alpha-phase uranium alloys, gamma-phase uranium alloys, plutonium, plutonium compounds, thorium, dispersion fuels, cermet fuels, coated-particle fuel materials, uranium oxides, uranium carbides, uranium nitrides, uranium-sulfides, fuel-water reactions, and irradiation effects in fuel materials is reviewed. (70 references). (M.C.G.)

18305 MODERATOR MATERIALS. Reactor Mater., 7: No. 1, 36-44(Spring 1964).

Research on graphite, beryllium metal and alloys, beryllium oxide, beryllium compounds, and solid hydrides is reported. (49 references). (M.C.G.)

18306 NUCLEAR POISONS. Reactor Mater., 7: No. 1, 45-7(Spring 1964).

Research on metallic and nonmetallic nuclear poison materials is reviewed. (8 references). (M.C.G.)

18307 CLADDING AND STRUCTURAL MATERIALS. Reactor Mater., 7: No. 1, 48-70(Spring 1964).

Research on corrosion of zirconium, aluminum, stainless steel, refractory metals, and nickel alloys and by liquid metals is reviewed. Studies of radiation effects on non-fuel materials, selected mechanical properties of cladding and structural materials, selected metallurgical aspects of cladding and structural materials, and ceramic technology are surveyed. (100 references). (M.C.G.)

18308 STUDIES OF FUSED SALT/LIQUID METAL TECHNIQUES APPLICABLE TO URANIUM AND OTHER PURIFICATIONS. P. M. C. Lacey, G. F. Hewitt, R. Murdoch, B. A. Partridge, J. A. Lacey, and M. E. Darlington (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Trans. Inst. Chem. Engrs. (London), 41: 342-53 (Dec. 1963).

A number of alternative semi-continuous procedures for reduction of uranium salts to the metal were examined on the laboratory scale. Some of them showed promise, particularly for uranium highly enriched in the fissile ^{235}U. These include the electrolysis of uranium-bearing halide melts onto a liquid metal cathode in which the uranium dissolves, followed by evaporation and recirculation of the solvent metal, and counter-current contacting of the salt melt by solvent metal containing a reductant (e.g. magnesium, produced in turn by electrolysis), again followed by evaporation. Thermodynamic and other data were determined for several of the reactions and materials involved. (auth)

18309 IMPROVEMENTS IN OR RELATING TO STEELS FOR USE IN NUCLEAR REACTOR STRUCTURES. (to Klockner-Werke AG). British Patent 953,088. Mar. 25, 1964. Priority date Oct. 22, 1959, Germany.

An austenitic steel is described which has a reduced tendency toward corrosion mass transfer and shortened life in a reactor. The steel differs from other austenitic steels in that it includes a rare earth, either Ce, Pr, and/or Nd. The composition of the steel is: 0.03 to 0.04% C, 0.3 to 0.6% Mn, 0.005 to 0.007% S, 17.0 to 19.0% Cr, 0.35 to 0.4% Si, 0.010 to 0.020% P, 0.05 to 0.15% Mo, 7.0 to 11.0% Ni, 0.0001 to 0.05% rare earth, and balance Fe. (D.L.C.)

18310 METHOD OF PULVERIZING GRAPHITE. Akinori Muta and Yasuhiko Uehara (Kabushiki Kaisha Hitachi Seisakusho). British Patent 953,592. Mar. 25, 1964. Filed Sept. 28, 1961.

A method for pulverizing graphite is given which produces fine-size graphite powder at a high yield rate in a short time. The method comprises carrying out the pulverization in an impact-type pulverizer in an atmosphere of dry gases at low pressure or in vacuum. This method results in the absorbed quantity of water vapor and oxygen on the graphite being less than a monomolecular layer, so that a more efficient pulverization can take place. (D.L.C.)

Corrosion

18311 (62RL3190M) CYCLIC-STRAIN-INDUCED OXIDATION OF HIGH-TEMPERATURE ALLOYS. L. F. Coffin, Jr. (General Electric Co. Research Lab., Schenectady, N. Y.). Dec. 1962. 10p.

Highly localized regions of surface oxidation were observed in three high-temperature alloys when subjected to cyclic plastic strain at elevated temperature. An explanation of the observed effects is given based on localized and reversed grain boundary deformation, leading to repeated rupture of the protective oxide film and accelerated oxidation in the region of deformation. These regions serve as nuclei for initiating fatigue cracks. (auth)

18312 CEA-tr-A-1455) RÉSISTANCE DES ACIERS À LA CORROSION PAR LE MERCURE ET L'AMALGAME AU SODIUM. (Resistance of Steels to Corrosion by Mercury and Sodium Mixtures). G. Jangg. Translated into French from Werkstoffe Korrosion, 13: 405-10(1962). 17p.

The corrosion of ferrous alloys containing various percentages of C, Si, Mn, P, S, Cr, Ni, Mo, Ti, Nb, and Cu by Hg, Na amalgam, and a mixture of amalgam and NaCl was investigated at 200 to 500°C. Alloys with a low content in Ni and Mn had good resistance to attack by Hg, as did austenitic Cr and Ni–Cr steels. Chrome steel with a low Ni content appears to be most suitable for use with Na amalgam. Chrome steels also proved to be sufficiently resistant to the amalgam-chloride mixture. (D.C.W.)

18313 (KAPL-3017) THE SOLUBILITIES OF Ni–Cr–Fe ALLOY 600 CORROSION PRODUCTS. Merle E. Jones (Knolls Atomic Power Lab., Schenectady, N. Y.). Feb. 10, 1964. Contract W-31-109-eng-52. 44p.

The solubilities of Ni–Cr–Fe Alloy 600 corrosion products formed at 550°F in ammoniated water, were determined as functions of time, temperature (75 to 650°F), and pH (8.5 to 10.5). Measurements were also made with pH-10.0 lithiated water to determine the effect of another pH agent. The effects of oxygen concentration in solution and of preconditioning the Alloy 600 surface are also described. (auth)

18314 (MSAR-64-18) EFFECT OF HIGH TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS. PHYSICAL PROPERTIES OF MATERIALS. Topical Report No. 2. RESULTS OF PHYSICAL PROPERTY TESTS OF 316 SS SPECIMENS IN 1200 F SODIUM WITH LOW OXYGEN. R. C. Andrews and K. R. Barker (MSA Research Corp., Callery, Penna.). Mar. 1964. Contract AT(11-1)-765. 82p.

A program is in progress in which the physical properties of 316 stainless steel and 2¼ Cr–1 Mo steel are compared in dynamic sodium systems at 1200°F and 1100°F respectively. This report presents the results of the first test series in which the fatigue, tensile, creep and creep-to-rupture properties of Type 316 ss were compared in 1200°F sodium, air, and helium environments. The results of these tests revealed: (1) The stainless steel specimens to be used throughout the program were representative of an average Type 316 ss heat. (2) The high temperature (1200°F) fatigue life of 316 ss in helium is longer than in air. The fatigue

life of 316 ss in 1200°F sodium is the same as in air at high cyclic strains but is the same as in 1200°F helium at the low cyclic strains. Short time exposure to 1200°F sodium prior to high cyclic strain tests did not appreciably effect the life in sodium and helium but shortened the life in air. (3) No significant differences in the creep-rupture properties of 316 ss were discernible in air, sodium, or helium at 1200°F. Specimens exposed for 4000 hours (unstressed) in 1200°F sodium also showed no significant change in creep-rupture properties. (4) The creep rates of 316 ss appear to be consistently higher in 1200°F helium and sodium compared to 1200°F air; however, the results show the stresses to produce a minimum creep rate of 1% in 10,000 hours in all three environments to be within a 15% spread. (5) Tensile properties showed no significant differences when tested in air or helium regardless of whether the specimens were exposed for 4000 hours to sodium or whether the exposed specimens were washed or unwashed prior to testing. (auth)

18315 (MSAR-64-30) EFFECT OF HIGH-TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS. PHYSICAL PROPERTIES OF MATERIALS. Progress Report No. 42, February 1964. (MSA Research Corp., Callery, Penna.). Mar. 20, 1964. Contract AT(11-1)-765. 18p.

The effects of air, helium, and high and low oxide sodium on the creep-rupture and tensile properties of chromium–molybdenum steel at 1100°F are evaluated. The effects of carbon and oxygen in the stainless steel corrosion loop are analyzed with respect to concentration and plugging. (N.W.R.)

18316 (ORNL-3598) COMPATIBILITY OF UNSUPPORTED PYROLYTIC-CARBON COATED URANIUM DICARBIDE PARTICLES WITH WATER VAPOR. J. P. Blakely, N. V. Smith, and L. G. Overholser (Oak Ridge National Lab., Tenn.). Apr. 1964. Contract W-7405-eng-26. 31p.

Five batches of pyrolytic-carbon-coated uranium carbide particles were exposed to partial pressures of water vapor ranging from 20 to 635 mm Hg at temperatures of 700 to 1100°C. All batches of coated particles had laminar type of coating and contained cores consisting principally of uranium dicarbide. The rate of reaction of the pyrolytic-carbon coatings with water vapor was determined from weight losses. The extent of failure of the coatings during exposure was established by microscopic examination and leaching of the particles with 8M HNO_3. Differences in the protectiveness of coatings present on the various batches of particles are attributable, at least in part, to two types of attack by water vapor, a localized or pitting type and a more general type. Rapid failure of the coatings was indicated at 1100°C. The coatings on some batches of particles remained protective at temperatures of 800 to 1000°C. (auth)

18317 (EURAEC-631) QUARTERLY REPORT NO. 3 [ON STEELS], JANUARY 1–MARCH 31, 1963. G. Chaudron (France. Centre National de la Recherche Scientifique, Paris). Work Performed under United States–Euratom Joint Research and Development Program. Contract 085-62-7-RDF. 18p. (A translation).

Stainless steels of different purity (Steel No. 5, 6, and 7) were analyzed as to their metalloid impurities. The micrographic structures were studied after various treatments: slow cooling, superhardening, and immersion in liquid nitrogen. For steel 7(18-10) the structure at room temperature was affected by liquid nitrogen immersion. The distribution of the austenite and martensite phases was analyzed by different methods: measurements of density differences, measurements of crystalline parameters, and thermomagnetic measurements. Vickers hardness measurements were effected; hardness evolution was followed after tempering treatments at 450°C. Determinations of weight losses in hydrochloric acid indicate important differences in these three steels, high-purity steel 7 being by far the most resistant. (auth)

18318 (EURAEC-836) [CORROSION OF STAINLESS STEELS]. Quarterly Report No. 5, July 1 to September 30, 1963. G. Chaudron (France. Centre National de la Recherche Scientifique, Paris). Work Performed under United States–Euratom Joint Research and Development Program. Contract RDF-085-62-7. 21p. (A translation).

Preparation and corrosion of stainless steels were investigated. In accelerated tests of pitting corrosion in ferric chloride, the best resistance was offered by the purest steels (Steels No. 3 and 7). The resistance to corrosion under tension was estimated by bending tests in boiling magnesium chloride. While commercial steel of type 0 gave way after 30 to 40 hours, steel 7 in the austenitic state did not even fracture after 380 hours. The results of corrosion tests in steam in the autoclave (400°C–130 kg/cm^2–3 weeks) showed a slight improvement of the rate of corrosion of austenitic steel 7 of high purity with respect to commercial steel. Electrochemical tests were made for showing the main features of the passivation layers formed on various kinds of steel in certain media such as air and nitric acid. (auth)

18319 (EURAEC-953) FURTHER DEVELOPMENT OF ZIRCONIUM ALLOY $ZrNb_3Sn1$ WITH REGARD TO ITS UTILIZATION AS JACKETING MATERIAL IN WATER-COOLED NUCLEAR REACTORS. Quarterly Report No. 1, October 1 to December 31, 1963. (Metallgesellschaft A.F., Frankfurt am Main). Jan. 27, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 019-63-11-TEED. 47p. (A translation).

Twenty-one alloys of the $ZrNb_3Sn1$ type with additions each time of 0.1, 0.2, and 0.5% of chromium, iron, germanium, copper, antimony, tellurium, and vanadium were melted and made into sheets. The lower boundary of the α/β conversion field was unaffected by 0.5% chromium, iron, germanium, copper, or tellurium, and on the addition of 0.5% vanadium or antimony, the conversion no longer occurred below 610°C. All additives except antimony were soluble to a slight extent only, so that even with an addition of 0.5% of these elements intermetallic phases occurred. With the test periods so far achieved the corrosion tests showed no improvement through additions in 400°C steam. In 480°C steam an improvement was found due to additions of iron and germanium. Use was again made of alloys with tin contents of less than 1%. (auth)

18320 (EURAEC-976) [CORROSION OF STEELS]. Quarterly Report No. 6, October 1, 1963–December 31, 1963. G. Chaudron (France. Centre National de la Recherche Scientifique, Paris). Work Performed under United States–Euratom Joint Research and Development Program. Contract 085-62-7-RDF. 20p. (A translation).

A new 18-10 high-purity steel was prepared called Steel No. 8. The characteristics were determined, particularly the proportional contents of nitrogen, M_S point, and corrosion in hydrochloric medium. The comparative study of corrosion under stress in pure and commercial steel was pursued. The result was the construction of an apparatus in which the stress is applied within the reagent

in the form of an axial tension. The first results have confirmed those obtained by deflection. Observations showed that commercial steel has a life of one hour, whereas 18/10 high-purity steel breaks only after some fifteen hours. Fabrication of a dual-phase austenitic-martensitic structure in pure steel renders the steel practically impervious to corrosion under stress. In boiling nitric acid with an addition of potassium bichromate (Cr^{6+} ions), results evidenced the favorable influence of purity on the resistance to corrosion. (auth)

18321 THE PARABOLIC OXIDATION KINETICS OF ALPHA ZIRCONIUM AT 850°C. G. R. Wallwork (Atomic Energy of Canada Ltd., Chalk River, Ont.), W. W. Smeltzer, and C. J. Rosa. Acta Met., 12: 409-15(Apr. 1964).

An investigation is reported on the oxidation properties of alpha-zirconium at 850°C in oxygen for exposures extending to 400 hr. The kinetics were determined by volumetric and gravimetric techniques and may be represented for exposures to approximately 200 hr by the parabolic relationship: $(\Delta M/A) = (2.1 \times 10^{-5})\sqrt{t}$ g.O/cm^2. Scale thicknesses and oxygen gradients in the metal were determined by metallographic techniques. It is demonstrated that parabolic diffusion relations derived from an oxide-metal model account for the kinetics of oxidation, scale growth, and oxygen solution in the metal. (auth)

18322 HARDENING MECHANISM AND CORROSION RESISTANCE OF NICKEL-BASE ALLOYS. A REVIEW. J. Chander (United Aircraft of Canada Ltd., Jacques Cartier, Que.). Can. Met. Quart., 3: 57-77(Jan.-Mar. 1964).

A review is presented on solid-solution-strengthening and precipitation-hardening mechanisms of nickel-base super alloys, as well as their history; the role of carbide and nitride reactions and the influence of these reactions, with heat-treatment, on the grain-boundary condition; and microstructural changes that occur with heat-treatment of some of the current nickel-base alloys. It is pointed out how corrosion resistance can interfere with the usefulness of these alloys, with special reference to oxidation and sulfidation. (auth)

18323 INHIBITION OF CORROSION BY THE PERTECHNETATE ION. G. H. Cartledge (Oak Ridge National Lab., Tenn.). Isotopes Radiation Technol., 1: No. 2, 125-9 (Winter 1963-64).

Experiments, which demonstrated that very effective inhibition of the corrosion of iron and steel can be achieved with low concentrations of pertechnetates under suitable conditions, are reviewed. Properties of technetium compounds related to inhibition are listed. Methods of studying inhibition are described, and theories on inhibition are discussed. (M.C.G.)

18324 STUDIES ON THE OXYGEN GRADIENTS IN OXIDIZING METALS. I. ZIRCONIUM. J. P. Pemsler (Kennecott Copper Corp., Lexington, Mass.). J. Electrochem. Soc., 111: 381-5(Apr. 1964).

The oxygen gradient beneath the oxide film on zirconium oxidized at 850°C for times ranging from 8 to 305 hr was measured. The technique used involves the measurement of the rate of dissolution of interference colored oxide films. Experimentally determined gradients are in good agreement with a theoretical expression involving the diffusivity, time, and oxide film thickness. Metallography and microhardness measurements demonstrated the existence of a number of phases in the oxygen containing metal substrate. These are believed to be associated with order-disorder reactions. No evidence of zones of constant composition or steady-state gradients was observed. (auth)

18325 STUDIES ON CORROSION OF GRAPHITE BY MOLTEN BISMUTH. Yuichiro Kamemoto, Yoshihisa Takahashi, and Shigeru Yamagishi (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 6: 71-6(Feb. 1964). (In Japanese)

Studies on corrosion of impermeable graphite by molten bismuth and molten bismuth–lead alloy were made under several conditions. Changes in the graphite samples, which were isothermally immersed in molten bismuth or bismuth–lead alloy at 450, 550, or 700°C for 210 hr, were observed in neither weighing nor microscopic tests. If the thermal cycle of heating (550°C)–cooling (solidification) was added to the bismuth in which the graphite samples were dipped, cracks were induced in the samples. It was found by microscopic and autoradiography techniques that this result was caused by the volume expansion of bismuth. When the bismuth filled in pin-holes of graphite solidified, the bismuth expanded and spread the pin-holes. The pin-holes were connected to each other and grew into cracks. (auth)

18326 SOME FACTS ABOUT STRESS CORROSION OF AUSTENITIC STAINLESS STEELS IN REACTOR SYSTEMS. Warren E. Berry (Battelle Memorial Inst., Columbus, Ohio). Reactor Mater., 7: No. 1, 1-13(Spring 1964).

Examples of stress-corrosion cracking of austenitic stainless steels encountered in established reactor systems are presented. These include: the Homogeneous Reactor, Savannah River Reactor Plant, heat exchanger at Capenhurst, Nautilus nonregenerative heat exchanger, S1W Reactor Plant, Superheat Advance Demonstration Experiment, Shippingport Pressurized Water Reactor, and Dresden control-rod components. Measures to eliminate stress-corrosion-cracking susceptibility are discussed, including: reducing stress levels, altering the chemistry of the environment, cathodic protection, changing the design or operating conditions, substituting alternative materials, and, on a long-range basis, understanding the mechanism of cracking. Various theoretical and experimental attempts to analyze and explain the cause of stress corrosion are summarized. (M.C.G.)

18327 KUNSTSTOFFE ALS SCHUTZ GEGEN KORROSION. (Synthetic Materials for Protection Against Corrosion). Bruno Waeser. Heidelberg, Dr. Alfred Huethig Verlag GmbH, 1963. 116p.

Principles of the use of synthetic materials in corrosion technology are discussed. Kinds of corrosion, behavior of synthetic material in stress corrosion, preparation of the surfaces to be protected, fixing the protective layers, and advantages and disadvantages of synthetic materials in corrosion technology are described. Uses of synthetic materials for protection against air, water, soils, chemical and thermal attacks, and radiation are discussed. Methods of investigation and standardization procedures are described. A listing of German patents and 240 references are given. Author and subject indexes are included. (M.C.G.)

Fabrication

Refer also to abstract 19264.

18328 (ASD-TDR-7-945(III)) LINER FOR EXTRUSION BILLET CONTAINERS. Interim Technical Documentary Progress Report, February 1–April 30, 1963. S. A. Spachner (Illinois Inst. of Tech., Chicago. Armour Research Foundation). May 1963. Contract AF33(657)-8784. 21p. (AD-407260)

A shrink-fit assembly device for buildup of ceramic-

coated liner and sleeve assemblies was tested and modified to develop desired temperatures and suitable heat distribution in sleeves, which were heated. Nine different compositions of fiber metal reinforced ceramic compacts were produced for preliminary evaluation of suitability for extrusion liner use. Procedures were developed for welding short, hollow ceramic cylinders of high-strength metal carbides and borides to form a ceramic extrusion liner of suitable length. Dissassembly tooling for rapid separation of shrink-fitted sleeves from a worn liner was designed, fabricated, and tested. Preliminary extrusion testing of an alumina-coated liner was carried out, using SAE 4340 steel billets extruded to rod at 12:1 and 16:1 ratios. No coating wear was noted after extrusion of 3 billets. (auth)

18329 (ASD-TDR-7-945(IV)) LINER FOR EXTRUSION BILLET CONTAINERS. Interim Technical Documentary Progress Report, May 4–August 4, 1963. S. A. Spachner (Illinois Inst. of Tech., Chicago. IIT Research Inst.). Contract AF33(657)-8784. 18p. (AD-416642)

Rokide-process alumina and zirconia coatings and a Udimet 700 superalloy liner were evaluated by extrusion of 3½-in. billets of Inconel 713C, Udimet 700, SAE 4340, PH15–7Mo, and TZM alloys, using rod extrusion dies of 12:1, 16:1, and 40:1 ratio, and T-section dies. Billet temperatures were in the 1900 to 2250°F and 2900 to 3600°F ranges. Both alumina and zirconia coatings provided adequate protection to the support tooling at temperatures to 3450°F. Alumina coatings showed wear at temperatures over 2900°F, but may be serviceable to 3450°F. Zirconia coatings showed erratic results. One coating did withstand extrusion at 3450°F without apparent wear. The Udimet 700 liner did not show wear at 2000°F, but did react with the TZM billet at 3600°F. T-section die design was modified to prevent die cracking during extrusion and reduce coating grinding costs. (auth)

18330 (EURAEC-12) URANIUM OXIDE EXTRUSION. Quarterly Report No. 1. (Compagnie Industrielle des Céramiques Electroniques, Paris). Dec. 15, 1959. Work Performed under United States–Euratom Joint Research and Development Program. Contract EUR/C/1323/3/59. 22p.

[This Report Supersedes TID-12482].

Rotary cylindrical rods are made of natural uranium oxide with a density above or equal to 92% of the theoretical density (10.87 g/cm^3) by camphor extrusion of uranium oxide of average specific surface (7 m^2/g). Up to 100 mm in length, deformation during sintering is acceptable and allows later rectification of the rods. The dimensional tolerance of ±1% on the diameters is respected. The specific surface of the raw material is a deciding factor in the densification of the rods during sintering. Of the bonds tried up to the present, camphor has given the best results. The characteristics of the dies may have an influence on the density, the behavior during sintering, and the appearance of the extruded rod. Sintering conditions probably have the greatest influence on the geometry of the treated rods. (auth)

18331 (LA-1180) DEVELOPMENT OF TECHNIQUES FOR ROLLING URANIUM METAL. D. E. Deutsch, G. S. Hanks, J. M. Taub, and D. T. Doll (Los Alamos Scientific Lab., N. Mex.). Nov. 15, 1950. Contract W-7405-eng-36. 139p.

Uranium can be rolled from cast metal or forged ingot to sheet satisfactory for cupping, deep drawing, and similar fabrication procedures by a combination of hot breakdown in the neighborhood of 600°C and warm finishing at 225 to 325°C. Sheet may also be obtained by hot rolling alone and by warm rolling alone, but the combination of hot and warm rolling afforded the best and most practical method to secure good quality sheet in the quantity required. The percent reduction by hot working does not appear to be critical, but at least 60% warm reduction is desirable to obtain complete and controlled grain size by recrystallization with high ductility and strength properties. Except for research investigation, rolling of uranium below 225°C is not recommended. Hot rolling of unplated uranium from the as-cast or as-forged surface is recommended, using a bath of 35% Li_2CO_3 plus 65% K_2CO_3 for a heating medium. No further preparation other than washing the salt from the hot rolled surface is required before warm rolling, and a bath of Meltemp No. 7 oil is recommended for warm rolling. Starting with an as-cast tensile strength averaging 60,000 psi, as-rolled sheet up to 230,000 psi was produced, with elongation averaging 5–8% and tensile to yield strength ratios averaging 75%. Uniform, equi-axed grains are produced upon annealing, and grain sizes can be controlled by choice of annealing temperature and time. (P.C.H.)

18332 (NAA-SR-Memo-9435) BRAZING AND NONDESTRUCTIVE TESTING OF THROAT-TO-COPPER BRAZE JOINT; SNAP-10A PUMPS. B. L. Sternoff and M. J. Mullery (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 20, 1964. Contract AT-11-1-GEN-8. 27p.

Brazing alloys and processes were evaluated for bonding 347 stainless steel to OFHC copper. Among the alloys and processes examined, the gold–copper–nickel brazes (Nicoro 80 and Premabraze 409), when brazed in vacuum appear to be the most suitable for use in the throat-to-copper braze joint. Metallographic and microprobe studies of Au–Ni–Cu braze joints that were held in vacuum at 1200°F for periods up to 2000 hours corroborate the conclusion. Shear strength tests of the gold base braze specimens show that the joint is structurally stable after exposure tests. A non-destructive testing technique employing ultrasonics was also developed. This technique can be successfully used for the determination of the amount of sound, bonded area in the throat-to-copper braze joint. (auth)

18333 A SIMPLE TECHNIQUE FOR SPOT WELDING MOLYBDENUM. A. P. Saunders (Univ. of Pennsylvania, Philadelphia). J. Sci. Instr., 41: 112(Feb. 1964).

The method described avoids the necessity for an inert atmosphere by wetting the surfaces to be welded with aqueous KOH solution and welding the surfaces together while they are still wet. The method is found useful for spot-welding Ti, W, and Cu, as well as Mo. (T.F.H.)

18334 A SIMPLE METHOD FOR VACUUM SEALING RADIOACTIVE SOURCES. R. A. Llewellyn (Purdue Univ., Lafayette, Ind.). Nucl. Instr. Methods, 25: 171-2(Dec. 1963).

Described is a relatively simple method for sealing radioactive sources containing compounds or elements that sublime so that they may be used in evacuated systems without causing contamination. The method was used to seal several ^{203}Hg sources that were subsequently used for several weeks at a pressure of 5×10^{-5} mm Hg with no vacuum system contamination. (auth)

18335 INFLUENCE OF DISPERSION UPON THE DENSIFICATION OF NIOBIUM CARBIDE PARTS AT VARIOUS SINTERING TEMPERATURES. A. I. Avgustinik, V. Sh. Vigderhaus, V. M. Gropyanov, and G. V.

Drozdetskaya (Leningrad Inst. of Tech.). Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 6, 11-17(Nov.-Dec. 1963). (In Russian)

After being ground in a vibro-mill, niobium carbide powder was pressed and sintered in a vacuum furnace. The result was that the sintering temperature was decreased if the NbC powder was fine. The possibility of calculating the necessary niobium carbide sintering temperature and the fineness of grinding for the production of material with a high relative density and the largest particle size of niobium carbide to start the densification sintering process is shown. The estimated niobium carbide energy level of the destruction lattice is equal to 100,000 cal/mole. (auth)

18336 SINTERED FILTERS MADE OF REFRACTORY COMPOUNDS. V. M. Sleptsov and S. A. Kubli (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 6, 54-7(Nov.-Dec. 1963). (In Russian)

Modes of fabricating filtering materials from powders and granules of refractory compounds were worked out: carbides of titanium, niobium, and chromium, titanium nitride, and zirconium boride. The bending strength, porosity, and permeability of the resulting filtering materials were investigated. (auth)

18337 ON CYCLIC SINTERING OF METAL POWDERS. A. F. Silaev, R. F. Kostechko, and Yu. F. Grigorova. Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 6, 58-61 (Nov.-Dec. 1963). (In Russian)

It is shown that after eleven cycles of sintering under conditions of 1200–800°C a stage of porosity stability of the sample sets in, and a stage of exhaustion of shrinkage. Cyclic sintering has no advantages over isothermal sintering: with equal temperatures and summary durations during sintering, the magnitude of porosity of the samples is the same. (auth)

18338 SPECIAL FABRICATION TECHNIQUES. Reactor Mater., 7: No. 1, 71-80(Spring 1964).

Research and development progress on melting, hot and cold working, cladding procedures, welding and brazing, explosive forming, and nondestructive testing is reviewed. (43 references). (M.C.G.)

18339 PREPARATION OF SINGLE CRYSTALS BY ARC-ZONE MELTING. O. N. Carlson, F. A. Schmidt, and W. M. Paulson (Ames Lab., Ames, Iowa). Trans. Am. Soc. Metals, 57: 356-8(Mar. 1964). (IS-754)

A method for preparing single crystals that is not only simple and convenient but also yields crystals of considerable size is reported. Using an arc-zone refining technique, single crystals of Re, Ta, Mo, Nb, V, Cr, and Y at least ½ in. in diam. and up to 5 in. in length were obtained. (P.C.H.)

18340 METHOD FOR PREPARING UO_2 COMPACTS. (to U. S. Atomic Energy Commission). British Patent 953,977. Apr. 2, 1964. Priority date May 19, 1961, United States.

A modification of the process for preparing compressed, sintered UO_2 compacts, is described which gives increased green compact strength and thus enables the green compacts to be compressed at higher pressures to result in increased green and sintered densities. The modification consists in providing 2 to 5 wt % water in the highly sinterable UO_2 and converting the resulting UO_2 to free-flowing particles, which are then compressed at a pressure of 10,000 to 15,000 psi and sintered in a reducing atmosphere. Several examples of the process are given which compare the results obtained with and without water. (D.L.C.)

Properties and Structure

18341 (AECL-1888) STRAIN-INDUCED DIRECTIONALITY OF ZIRCONIUM HYDRIDE PRECIPITATES IN ZIRCONIUM–2.5 WT. % Niobium–0.5 WT.% COPPER ALLOY. G. W. Parry (Atomic Energy of Canada Ltd., Chalk River, Ont.). Dec. 1963. 18p.

A description is given a series of tests on zirconium–2.5 wt % niobium–0.5 wt % copper alloy to determine the effect of heat treatment on strain induced directionality of hydride precipitates. It was found that introduction of strain following heat treatment resulted in directionality of the hydrides, whereas, if heat treatment followed straining, directionality was not produced. It is concluded that the most suitable fabrication sequence to produce a random hydride orientation in garter springs of Zr–Nb–Cu is to carry out heat treatment after coiling into springs. (auth)

18342 (DRI-2153) DETERMINATION OF THE NIOBIUM-RICH DESIGN OF THE TERNARY PHASE DIAGRAMS, NIOBIUM–TUNGSTEN–HAFNIUM AND NIOBIUM–TUNGSTEN–ZIRCONIUM. Quarterly Report No. 6. Albert S. Yamamoto (Denver. Univ. Denver Research Inst.). Mar. 1964. Contract AT(11-1)-1092. 14p.

Two isotherms at 1600 and 1300°C for the niobium–tungsten–hafnium alloy system are included. The lattice spacing data obtained from the alloys quenched from the two temperatures corroborate the metallographic placement of the niobium terminal solid solution boundaries in these two isotherms. Three modified microhardness contour diagrams for the niobium–tungsten–hafnium alloys annealed at 1600, 1300, and 1100°C are presented. The second phase appearing in the ternary alloy system was not identified by x-ray diffraction technique; however, the investigation is being continued. (auth)

18343 (CEA-2321) ETUDE DES ALLIAGES URANIUM–PLUTONIUM AUX CONCENTRATIONS COMPRISES ENTRE 0 ET 20% DE PLUTONIUM. (Study of Uranium–Plutonium Alloys Containing from 0 to 20% of Plutonium). Hanoch Paruz (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). 1963. 68p.

Thesis submitted to Université, Paris.

The work is carried out on U–Pu alloys in the region of the solid solution uranium alpha and in the two-phase region uranium alpha + zeta phase. The results obtained concern mainly the influence of the addition of plutonium on the physical properties of the uranium (changes in the crystalline parameters, the density, the hardness) in the region of solid solution uranium alpha. In view of the discrepancies between various published results as far as the equilibrium diagram for the system U–Pu is concerned, an attempt was made to verify the extent of the different regions of the phase diagram, in particular the two-phase region. Examinations carried out on samples after various thermal treatments (in particular quenching from the epsilon phase and prolonged annealings, as well as a slow cooling from the epsilon phase) confirm the results obtained at Los Alamos and Harwell. (auth)

18344 (CEA-2394) OBSERVATION DE LAMES MINCES DE BERYLLIUM AU MICROSCOPE ELECTRONIQUE. (Observations on Thin Sheets of Beryllium with the Electron Microscope). J. Beaudier-Antolin, J. M. Dupouy,

and Y. Adda (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1963. 31p.

Thin SR beryllium lamellae are examined by electron microscopy after various treatments, together with other samples made up of Be–Fe at 1 per cent and 0.2 per cent iron. The SR beryllium is examined after being annealed at 750°C and 900°C, strongly cold-worked, and quenched at 900°C. At 950°C the metal is perfectly annealed; at 750°C the polygonisation is almost complete, the dislocations are arranged either in dislocation walls in the prismatic planes, or in hexagonal lattices with non-dissociated nodes suggesting a high stacking defect energy. The cold-worked structure has a high dislocation density and already existing crystal walls. In the quenched state, the few dislocations are very straight and are aligned in the crystallographic directions. Iron precipitation is studied in two alloys during tempering at 660° after quenching in salt water. The precipitate appears at the grain boundaries and then spreads through the matrix leaving a depleted zone in the neighborhood of the joints. These precipitates, in the form of platelets parallel to the base planes of the beryllium lattice, have been identified as the intermetallic phase Be_{11} Fe oriented in relation to the matrix
(0001) || (0001)
$(10\bar{1}0)$ || $(11\bar{2}0)$. (auth)

18345 (GEAP-4411) ANALYSIS OF UO_2 GRAIN GROWTH DATA FROM "OUT-OF-PILE" EXPERIMENTS. M. F. Lyons, D. H. Coplin, and B. Weidenbaum (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Nov. 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 53p. (EURAEC-1003)

Data on equiaxed UO_2 grain growth from "out-of-pile" experiments have been gathered from all known sources and analyzed to determine the relationship between the grain size developed and annealing temperature and between grain size and the time at temperature. On the basis of the analysis, an equation relating grain size to time and temperature has been selected that appears to best describe the data considered as a whole. The coefficients in this grain growth equation have been evaluated to indicate the variance between different investigations and/or different UO_2 sinters. The general applicability and limitations of "out-of-pile" grain growth data for the determination of temperatures in the microstructures of irradiated UO_2 are discussed. Specific recommendations are made for the conditions under which grain size can be reliably employed as a temperature indicator. The objective in undertaking this analysis on UO_2 grain growth was to obtain a working relationship between UO_2 grain size and annealing time and/or temperature, and also a measure of the potential variation in the relationship. The intended use of the results was the determination of temperatures based on the grain sizes observed in the post-irradiation metallographic examination of the AEC-Euratom High Performance UO_2 Program fuel capsules. (auth)

18346 (HW-74884) REVIEW OF THE FATIGUE SENSITIVITY OF STEELS TO NOTCHES AND CRACKS AND APPLICATION TO NPR PRIMARY PIPE. W. J. Love (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 31, 1962. Contract AT(45-1)-1350. 51p.

Results are reported of the literature review and analysis program investigating the effect of notches and cracks upon the fatigue strength of wrought steels. No universal analytical model now exists which defines the fatigue performance of notched or cracked vs unnotched specimens. There are however, semi-empirical relations which demonstrate a fair degree of correlation for wrought steels. A comprehensive survey was made of the existing data and theory. The major effective stress concentration factor theories depend upon mechanical material properties and are expressed in the form of minimum notch sharpness parameters to provide an upper limit of effective stress concentration factor. While differing quantitatively because of differences in mathematical derivation, these parameters have been correlated with tensile strength for wrought steel with reasonable success. The stress concentration work of Neuber as extended to fatigue by Kuhn and Hardrath, was modified to cover the effect of limiting root radius parameter to many notch geometries not covered in the original reports. The method of Neuber-Kuhn and Hardrath was compared with the methods of Peterson and Frost and found to be in reasonable agreement, particularly for the lower strength steels. It was found that the tensile strength-notch-parameter relationship developed by Kuhn and Hardrath was conservative particularly for high strength steels and could be applied to either notches or cracks. The flexibility of application of this parameter to a wide range of crack geometries and structural loading conditions was achieved by the modified Neuber relation derived herein. Curves showing representative effective stress concentration factor vs crack length demonstrate the trend to be expected under direct load conditions. Corrections for flaws skewed with respect to maximum principle stress, mean stress, surface discontinuities, limited length, low cycle life, as well as for applied principle stress gradients other than zero act to further reduce the effective stress concentration factor. (auth)

18347 (HW-77464) ULTRASONIC RESPONSE OF NOTCHES IN 35-MIL-WALL ZIRCALOY TUBING. N. E. Dixon (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 2, 1964. Contract AT(45-1)-1350. 24p.

Graphic plots of notch depth versus ultrasonic amplitude response for 750 mil O-D, 35 mil wall, Zircaloy tubing are presented. Tabulation of other effects observed in taking the data is included. Emphasis is placed on presenting the necessary data and results for practical application in ultrasonic sheath tubing tests. A discussion of the experimental equipment, notches, experimental parameters, test system setup, and interpretation of data with detailed conclusions is included. For a longitudinal test, an entry angle of 27°, which corresponds to shear waves propagating at 45° between wall boundaries, gave the most favorable signal relationships for defects oriented parallel to the tube axis. For a transverse test, Lamb modes near, but above, the critical angle for longitudinal wave propagation yielded the most favorable signal relationships for defects oriented circumferentially to the tube axis. The most favorable signal relationships were obtained with a 5 Mc spherically focused transducer in the longitudinal test and a 10 Mc spherically focused transducer in the transverse test. For these experimental conditions, notch depth versus amplitude response curves are nonlinear and each mode presents an individual response curve. Inside surface notches versus outside surface notches for a given mode are not necessarily equal in amplitude, do not necessarily present amplitude peaks at the same point in time, and do not necessarily follow the same response curve. For a given mode and test system many variables exist, which may significantly affect

notch depth versus amplitude response curves. Some of the significant variables are beam dimension and shape, transmit pulse length and frequency, instrument stability, and the characteristics of individual mode response to defects. (P.C.H.)

18348 (IITRI-B183-16) FRACTURE OF METALS. Summary Report, March 22, 1963–March 22, 1964. (Illinois Inst. of Tech., Chicago. IIT Research Inst.). Apr. 2, 1964. Contract DA-11-ORD-022-3108. 37p.

Delayed failure is shown to occur with high-strength metals, such as Be–Cu and brass, wetted by certain embrittling liquid metals. Dispersion-strengthened and cold-worked metals are prone to delayed failure but soft, annealed metals are not. Cracking during the period of sustained loading can only be detected in the last few minutes before failure. A mechanism is proposed based on stress-accelerated intergranular penetration. Thus, failure time depends on both stress and temperature. Below a certain stress (endurance limit), temperature alone is inadequate, and failure does not occur. Certain preconditioning anneals retard and suppress delayed failure. A method is described for measuring the fracture energy of polycrystalline metals in the presence of a low-melting liquid metal. (auth)

18349 (LADC-5779) EFFECTS OF TEMPERATURE AND STRAIN RATE ON TRANSVERSE TENSILE PROPERTIES OF H4LM GRAPHITE TESTED IN HELIUM AND IN VACUUM. Morton C. Smith (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract W-7405-eng-36. 29p.

Curves are presented showing the ultimate tensile strength of molded H4LM graphite in the transverse orientation (with the grain) as a function of temperature, for tests made in vacuum and in static helium at nominal engineering strain rates of 0.005, 0.5, and 2.0/min. Temperature ranges considered are ambient to 2000°C for tests in vacuum, and ambient to 2500°C for those in helium. A general increase of strength occurs as temperature rises; however, the magnitude of the strength increase is reduced by testing at the higher strain rates. Fracturing of graphite is discussed, and it was concluded that the results can best be explained in terms of a selective mass-transport mechanism that heals, or at least blunts, dormant cracks formed early in the fracture history. (auth)

18350 (NMI-2809) STUDY OF URANIUM–ALUMINUM–IRON TERNARY CONSTITUTION DIAGRAM. Progress Report for the Period Ending March 31, 1963. R. B. Russell (Nuclear Metals, Inc., West Concord, Mass.). Apr. 18, 1963. Contract AT(40-1)-3022. 10p.

The determination of the U–Al–Fe constitution diagram up to about 1000 ppm each of aluminum and iron is now being implemented by a determination of the U–Al and U–Fe binary systems. The techniques to be used for this study include optical, electron and x-ray metallography, microprobe analysis, electrical resistance, and hot-hardness measurements. It is expected that a combination of techniques will give evidence of the amount of solid solubility of aluminum and iron in alpha uranium from 300 to 660°C, and in beta uranium at selected higher temperatures. (N.W.R.)

18351 (NMI-2811) PROGRESS ON THE STUDY OF THE URANIUM–ALUMINUM–IRON CONSTITUTION DIAGRAM FOR THE PERIOD SEPTEMBER 1–DECEMBER 31, 1963. R. B. Russell (Nuclear Metals, Inc., West Concord, Mass.). Jan. 8, 1964. Contract AT(40-1)-3022. 46p.

The U–Al–Fe constitution diagram up to about 1000 ppm each of aluminum and iron is studied. The techniques used for this study include optical, electron, and x-ray metallography; microprobe analysis, electric conductivity, and hardness measurements. A combination of techniques are giving evidence of the amount of solid solubility of aluminum and iron in alpha, beta, and gamma uranium at selected higher temperatures. The U–Al and U–Fe phase diagrams are also being determined. (N.W.R.)

18352 (ORNL-3587) THE VOLATILITY OF $UO_{2\pm x}$ AND PHASE RELATIONS IN THE URANIUM–OXYGEN SYSTEM. A. T. Chapman and R. E. Meadows (Oak Ridge National Lab., Tenn.). Apr. 1964. Contract W-7405-eng-26. 32p.

The volatility of $UO_{2\pm x}$ and the phase relations in the uranium-oxygen system were studied using thermogravimetric techniques. Chemical reactions describing the loss of uranium from $UO_{2\pm x}$ at temperatures between 1100 and 2200°C in oxygen pressures between approximately 10^2 and 10^{-6} torr are proposed. The uranium-bearing vapor species above UO_{2+x} appears to be $UO_4(g)$. Evidence supporting the existence of $UO_4(g)$ included the volatilization of material with an oxygen-to-uranium ratio of 4 during the decomposition of UO_{2+x} $(0.2 > x > 0)$ to near-stoichiometric UO_2 in vacuum above 1500°C and the dependence of the evaporation rate of the uranium dioxide on the oxygen pressure between 1200 and 1500°C. The equilibrium oxygen pressures over compositions between $UO_{2.02}$ and $UO_{2.63}$ in the UO_{2+x} and U_3O_{8-y} regions and over the boundary between these phases were measured between 1000 and 1600°C. The equilibrium oxygen-to-uranium ratio of $UO_{2\pm x}$ was less than 2 above 1700°C in vacuum. (auth)

18353 (TID-20389) PROGRESS REPORT. PART I. STRUCTURE AND PROPERTIES OF TWO-PHASE ALLOYS. PART II. A COMBINED MACROSCOPIC AND MICROSCOPIC APPROACH TO THE FRACTURE OF DUCTILE METALS. D. C. Drucker and J. Gurland (Brown Univ., Providence). Mar. 19, 1964. Contract AT(30-1)-2394. 8p.

Investigations were made on the elastic moduli of Al–Si systems over a wide range of compositions and of residual temperature stresses as a function of composition from 5 to 90% Si. Consistent results on elastic moduli were obtained from compositions with 5, 11, 20, and 30% Si by volume. However, the elastic modulus of the 40% Si alloy is abruptly different from that of the previous alloy in the series. Temperature stresses for Al–Si alloys are hydrostatically compressive in the dispersed Si particles of Al-rich compositions, but change gradually to become predominantly tensile in Si-rich alloys. X-ray diffraction lines from the Al phase show considerable line broadening. Some preliminary results on the mechanism of crack initiation at inclusions in Al–Si alloys are discussed. (P.C.H.)

18354 (TID-20412) HIGH TEMPERATURE OXIDATION AND NITRIDATION OF NIOBIUM IN ULTRAHIGH VACUUM. Quarterly Report No. 4, August 1–December 31, 1963. R. A. Pasternak (Stanford Research Inst., Menlo Park, Calif.). Jan. 7, 1964. Contract AT(04-3)-215. 8p.

The electric conductivity of niobium ribbon is measured at 20 to 1755°C using thermocouple and pyrometric techniques. Equipment for nitridation of niobium in ultrahigh vacuum is being modified. (N.W.R.)

18355 (UCRL-7304) STRESS-STRAIN DISTRIBUTION IN LAP-JOINTED THIN SHELLS. S. A. Forsberg, J. Frisch, and R. F. Steidel, Jr. (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 14, 1963. Contract W-7405-eng-48. 35p.

Two hemispherical Mg shells and two cylindrical steel shells, all 10 in. in dia and 0.100 in. thick, were joined by

means of a simple interference lap joint. The stress distribution in the vicinity of each lap joint was determined analytically and verified experimentally. The assumption of uniform pressure on the lap-joint interface and the use of the theory of beams on elastic foundation show good agreement between the theoretical and experimental stress distributions. (P.C.H.)

18356 (UCRL-10627) DISLOCATIONS AND PLASTIC WAVES. John E. Dorn and S. L. Rajnak (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 1963. Contract W-7405-eng-48. 33p. (CONF-444-1)

From International Conference on Production Engineering Research, Pittsburgh, Sept. 1963.

A review of some of the major contributions of dislocation concepts to the understanding of plastic wave phenomena is presented. Von Karman and Taylor theory for plastic wave propagation, dislocations and shocks in strains, behavior of a Suzuki locked alloy, Peierls process, and thermally activated intersections are discussed. (P.C.H.)

18357 (UCRL-11160) EFFECT OF POLYSLIP ON STRAIN-HARDENING IN ALUMINUM SINGLE CRYSTALS (thesis). J. D. Mote (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 14, 1964. Contract W-7405-eng-48. 31p.

Investigations were carried out on the effect of polyslip on strain hardening in fcc single crystals. It is shown that the rate of strain hardening increases for the orientations wherein attractive dislocation intersections occur and that the orientations that produce the greater number of such intersections exhibit the greater strain hardening. It was found that the barrier reactions considered by Hirth are not responsible for any strengthening. Special experiments on specimens with a $[\bar{1}11]$ tensile axis revealed that the pre-exponential coefficient of the intersection equation is not constant as was previously assumed but varies by several orders of magnitude. Furthermore, at temperatures above the critical temperature, the deformation mechanism is thermally activated. (auth)

18358 (UCRL-11220) EFFECT OF HIGH PRESSURE ON THE ELECTRICAL RESISTANCE OF Bi, Yb, AND Dy (thesis). Philip Clark Souers (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry). Jan. 24, 1964. Contract W-7405-eng-48. 79p.

The experimental procedure of measuring the electrical resistance of Bi, Yb, and Dy is discussed in detail. By using Bridgman anvils, pressures as high as 100 kbars and temperatures between 77 and 633°K were reached. Above about 150°C, the temperature coefficient of resistance of bismuth is positive, as for a metal. Below 150°K in the region 15 to 35 kbars, the coefficient becomes negative, as is characteristic of semiconductors. When the exponential resistance formula is applied to the region in which bismuth is a semiconcuctor, the energy gap is found to be 0.006 ev at 15 kbars, with a steady rise to 0.018 ev at 35 kbars. At higher pressures, bismuth I transforms into a metallic modification with the normal temperature dependence of the resistance. The phase line for the large peak in the resistance-pressure isotherms of ytterbium was determined from 77 to 633°K. The value of dT/dP is about −20 deg/kbar, and the phase line extrapolates close to the known 1 atmosphere α-β transition. In the region 20 to 45 kbars, ytterbium shows a negative temperature coefficient of resistance. When the exponential resistance formula for semiconductors is used, ytterbium shows an energy gap of 0.015 ev at 20 kbars, an increase to a maximum of 0.080 ev at 37 kbars, and then a decrease to 0.05 ev at 45 kbars. Dysprosium was examined at 20°C and in the region 77 to 200°K. The Néel temperature decreases with pressure; dT_N/dP is -0.62 ± 0.04 deg/kbar. The Néel transition disappears in the region 45 to 55 kbars. The transition affecting the Néel line is visible as a shoulder in the resistance-pressure isotherms. Above the Néel line, dT/dP for this shoulder transition is very large and the sign of the slope is unknown. Below the Néel line, dT/dP is between −1 and −4 deg/kbar. The nature of this transition is unknown. (auth)

18359 (WADD-TR-61-72(Vol.XVIII)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XVIII. HIGH-TEMPERATURE TENSILE CREEP OF GRAPHITE. E. J. Seldin (National Carbon Co. Research Lab., Parma, Ohio). July 1963. Contract AF33 (616)-6915. 42p.

Tensile creep tests under conditions of constant load and constant temperature were performed on four different types of graphite. The temperature ranged from 2300°C to 2900°C. Some of the data were fitted to creep equations and the temperature and stress dependence of the steady-state creep rates were investigated. For National Carbon Company grade ATJ graphite, the creep rates yielded an activation energy of 124 kcal/mole and varied with the fourth power of the stress for specimens with two different grain orientations. The activation energy was found to be the same for all the other graphites which were tested. The creep was found to be greater in the direction "against the grain" than in the direction "with the grain," and differences in creep strain and creep rate for the two orientations were found to increase as the anisotropy of the graphite was increased. For one type of graphite, the creep of specimens oriented "with the grain" decreased as the density increased and was not sensitive to differences in the proportions of filler and binder carbon. (auth)

18360 (AEC-tr-6387) INORGANIC CHEMISTRY. CERIUM−MANGANESE ALLOYS. Aldo Iandelli. Translated from Atti Accad. Naz. Lincei, Rend., Classe Sci. Fis., Mat. Nat., (8), 13: 265-8(1952). 6p.

Phase studies on Ce−Mn alloys showed that Ce and Mn alloy incompletely, showing a miscibility gap in the liquid state between 45 and 64% Mn, with no intermediate phase, at least over the temperature range examined (500°C and above). The behavior is the same as that of the La−Mn alloys. Unlike these alloys, however, the miscibility gap is smaller for the Ce alloy, although it was expected to be larger, in view of their lower melting point. It is speculated that alloys of Mn with a rare earth not too far removed from cerium should show a diagram without immiscibility and with an intermediate phase. (P.C.H.)

18361 (CEA-tr-X-531) LE COMPORTEMENT DES PRODUITS DE FISSION A HAUTE TEMPERATURE. (The Behavior of Fission Products at High Temperature). Seishi Yajima. Translated into French from Kagaku To Kogyo (Tokyo), 16: 296-305(1963). 43p. (Includes original, 9p.)

The behavior of fission products in fuel systems involving metallic uranium, uranium dioxide, and UC in graphite was investigated. The diffusion of the fission products, particularly Xe and I, was studied, together with the relation of Xe and I diffusion to the release of stored energy. Capture of the fission products was also examined. The implications for the treatment of fission products in gas-cooled reactors were considered. (D.C.W.)

18362 TENSILE BEHAVIOR OF Mo POLYCRYSTALS UNDER ULTRAHIGH VACUUM. S. Feuerstein, L. Rice,

and H. Conrad (Aerospace Corp., El Segundo, Calif.). Appl. Phys. Letters, 4: 154-5(Apr. 15, 1964).

Observations of the stress-strain behavior of bulk molybdenum polycrystals under ultrahigh vacuum are reported. Experiments were performed at room temperature in an ion-pumped ultrahigh vacuum system positioned in an Instron tensile machine. The relative effect of strain rate on the fracture strain was investigated. It was concluded that a correlation exists between the surface desorption and the extended ductility under ultrahigh vacuum. (R.E.U.)

18363 THE DIFFERENT BEHAVIOUR OF HEXAGONAL AND CUBIC METALS IN THEIR FRICTION, WEAR AND WORK HARDENING DURING ABRASION. P. J. Alison and H. Wilman (Imperial Coll. of Science and Tech., London). Brit. J. Appl. Phys., 15: 281-9(Mar. 1964).

The mass wear per cm M and the friction coefficient μ of metals during abrasion on a relatively rigid hard rough surface are studied experimentally at 1 kg load and a speed of a few centimeters per second. "Smooth-cut" steel files were used as the abrasive surface, cleaned carefully by scratch-brushing rather than by etching, between consecutive experiments. In the mean, linear relations were observed, as expected theoretically, between the reciprocal of the volume–wear rate and the microhardness H_D of the filed surface (thus work-hardened to the maximum extent), but the loci were widely different for the cubic metals (Pb, Ca, Al, Ag, Cu, Pt, Fe, Ni, Mo, Cr) and the hexagonal metals (Cd, Mg, Zn, Zr, Ti). For a given surface hardness, the volume–wear rate for the hexagonal metals was about half that for the cubic metals, hence for the hexagonal metals a larger proportion of the metal is displaced by plastic flow (slip) from the groove volume instead of being removed as wear; and this is evidently because of easier slip, mainly on a single slip plane (0001), instead of multiple slip and the associated heavy work hardening as occurs in cubic metals. A single linear locus was obtained when the reciprocal of the volume–wear rate was plotted against the hardness of the annealed metals. For the cubic metals μ decreased mainly linearly with increasing H_D of the (work-hardened) filed surface, but for the hexagonal metals μ was practically constant, independent of H_D. The relatively rapid surface oxidation of Mg and Ca caused a decrease in μ relative to that of the other metals of similar structure and hardness. These results establish clearly that there is a fundamental difference in wear and friction behavior of hexagonal and cubic metals. (auth)

18364 COMPARATIVE STUDY OF ALLOTROPIC TRANSFORMATIONS OF FRITTED URANIUM AND MASSIVE URANIUM. Bernard Pinteau and Georges Cizeron (Ecole des Mines, Paris). Compt. Rend., 258: 1794-7 (Feb. 10, 1964). (In French)

The comparative study of allotropic transformations of fritted and massive uranium permitted the establishment of the effect of porosity associated with the presence of a low percentage of oxygen both on the amplitude of dilatometric abnormalities with respect to α/β and β/γ allotropic transformations and on the temperatures of these abnormalities. The temperatures were studied by thermal analysis. (tr-auth)

18365 THE PROPERTIES OF FUSED-ZONE ZIRCONIUM. Jean-Paul Langeron (CNRS, [Paris]). Compt. Rend., 258: 1801-4(Feb. 10, 1964). (In French)

The analysis and measurements of low-temperature electric resistivity have shown the effect of the last traces of impurities on the value of the resistivity ratio and on the recrystallization temperature. The process for the elimination of various impurities during zone fusion under static ultravacuum is also indicated. (tr-auth)

18366 DETERMINATION OF THE THERMAL DIFFUSIVITY OF PLUTONIUM. Antoine Radenac and Bernard Hocheid. Compt. Rend., 258: 2265-7(Feb. 24, 1964). (In French)

The thermal diffusivity was measured by the method of periodic thermal signals. The average value obtained was 0.02 cm^2/sec with a precision of 4%. (D.C.W.)

18367 STRUCTURE CHANGES IN ALPHA URANIUM MONOCRYSTALS DEFORMED BY DUCTILITY TO RUPTURE. F. P. Butra, Z. F. Evkina, and O. L. Fufaeva. Fiz. Metal. i Metalloved., 15: 873-9(1963). (In Russian)

Metallographic and x-ray structural analysis of room-temperature deformation in α-uranium monocrystals showed that an axial deformation texture along the (0 0 1) axis was formed at 50% elongation and up, independent of the initial crystal axis. The alterations in the crystal texture result from slip deformation, (0 1 0) to [1 0 0], and twinning, $\{1\,3\,0\}-\langle 3\,\bar{1}\,0\rangle$. (R.V.J.)

18368 TEMPERATURE DEPENDENCE OF Gd–Y PARAMAGNETIC SUSCEPTIBILITY. V. I. Chechernikov and Iulin Pop (Moscow State Univ.). Fiz. Metal i Metalloved., 15: 934-5(1963). (In Russian)

Paramagnetic susceptibility of Gd–Y alloys (25, 50, 65, 75, and 90 at. % Gd) at 300 to 1500°K was studied using a Faraday-Lucksmith type installation with 10^{-3} to 10^{-4} mm Hg vacuum. Diagrams show that the specific susceptibility fulfills the Curie-Weiss law and is a direct function of temperature. An analysis of the effective magnetic moment per atom of Gd shows that with a increased Y the effective atomic moment is reduced. (R.V.J.)

18369 ON THE PROPERTIES OF POWDERED AND MASSIVE UO_2 AND U_4O_9. Tsuyoshi Amanuma and Kazuo Sakamoto (Atomic Fuel Corp., Tokyo). Funtai Oyobi Funmatsuyakin, 10: 198-203(Oct. 1963). (In Japanese)

Samples of ceramic-grade UO_2 powder (O/U = 2.08) and crushed massive samples (0.325 mesh) of electrodeposited UO_2(O/U = 2.00$_5$), fused UO_2(O/U = 2.00$_3$), and electrodeposited U_4O_9-x(O/U = 2.10) were used to study oxidation behavior and crystal structure. Results of x-ray analysis and infrared spectrophotometry of heated samples, DTA curves, and the relationship between heating temperature and the O/U ratio of the samples are presented. The oxidation behavior of the samples were found to be substantially the same: UO_2(cubic) or U_4O_9-x(cubic) 200 to 400°C → U_3O_7(tetragonal) 340 to 425°C → U_3O_8(orthorhombic). Differences in the crystal transformation temperature of individual samples may be due to particle size and surface activity. Using infrared spectrophotometry, a small absorption at ~15.3 μ was recognized, which might be caused by the U_3O_7 phase. The electrodeposited U_4O_9-x single crystal was diamond shaped and very thin, quite different from the octahedron shape of electrodeposited UO_2. The regular triangular etch pits on the diamond-shaped face of the U_4O_9-x crystal show that this face is identical with the (111) face of the UO_2 crystal. (from NSA of Japan)

18370 PHASE RELATIONS IN THE SYSTEM UO_2–UO_3–Y_2O_3. S. F. Bartram, E. F. Juenke, and E. A. Aitken (General Electric Co., Cincinnati). J. Am. Ceram. Soc., 47: 171-5(Apr. 21, 1964).

Phase relations in the system UO_2–UO_3–Y_2O_3, particularly in the Y_2O_3-rich region, were examined by x-ray and chemical analyses of reacted powders heated at temperatures up to 1700°C in H_2, CO_2–CO, and air. Four phases were identified in the system at temperatures between 1000° and 1700°C: U_3O_8, face-centered cubic solid solution.

body-centered cubic solid solution, and a rhombohedral phase of composition $(U,Y)_7O_{12}$ ranging from 52.5 to 75 mole % Y_2O_3. The rhombohedral phase oxidized to a second rhombohedral phase with a nominal composition $(U,Y)_8O_{15}$ at temperatures below 1000°C. This phase transformed to a face-centered cubic phase after heating in air above 1000°C. The solubility of UO_2 in the body-centered cubic phase is about 14 mole % between 1000 and 1700°C but decreases to zero as the uranium approaches the hexavalent oxidation state. The solubility of Y_2O_3 in the face-centered cubic solid solution ranges from 0 to 50 mole % Y_2O_3 under reducing conditions and from 33 to 60 mole % Y_2O_3 under oxidizing conditions at 1000°C. At temperatures above 1000°C, the face-centered cubic solid solution is limited by a filled fluorite lattice of composition $(U,Y)O_2$. For low-yttria content, oxidation at low temperatures (<300°C) permits additional oxygen to be retained in the structure to a composition approaching $(U,Y)O_{2.25}$. A tentative ternary phase diagram for the system $UO_2-UO_3-Y_2O_3$ is presented and the change in lattice parameter and in cell volume for the solid-solution phases is correlated with the composition. (auth)

18371 GRAIN-BOUNDARY MIGRATION IN LiF BICRYSTALS. M. P. Davis and N. M. Tallan (Aerospace Corp., Wright-Patterson AFB, Ohio). J. Am. Ceram. Soc., 47: 175-8(Apr. 21, 1964).

Large-scale grain-boundary movements, apparently due to temperature-gradient zone melting, were observed in macroscopic LiF bicrystals. Bicrystals containing boundaries of varying orientations were prepared by sintering LiF single crystals at temperatures 20 to 30°C below their melting point in air and in argon. Although no appreciable amount of sintering was observed during prolonged heating periods at very slightly lower temperatures, at these temperatures a boundary capable of large-scale movement formed rapidly. Subsequent heating at the same temperature resulted in boundary movements of 5 mm or more with 12 hours, frequently in a direction opposed to the radius of curvature. In some specimens boundary sliding and rotation, strongly suggestive of the presence of an interfacial liquid layer, were observed. (auth)

18372 CONSTITUTION AND MICROSTRUCTURE OF SOME BINARY ALKALI HALIDE MIXTURES. J. G. Loxham and A. Hellawell (Oxford Univ.). J. Am. Ceram. Soc., 47: 184-8(Apr. 21, 1964).

The constitutions of binary alkali halide systems were considered for the fluorides, chlorides, and bromides of lithium, sodium, and potassium. The systems were divided equally into those that are simple binary systems having a common ion and those that are capable of double decomposition into reciprocal salt pairs, $AB + CD \rightleftharpoons AD + BC$. The studies were principally concerned with the constitution of the pseudobinary systems. Using thermal analysis x-ray methods, and microscopy, the liquids and temperature horizontals were determined for 18 such systems and the equilibria were interpreted with reference to quaternary systems. The tendency of a given salt pair to precipitate the reciprocal salts may be related to the relevant lattice energies. Microscopic examination of directionally frozen specimens revealed that true binary eutectic mixtures freeze with regular two-phase distributions very similar to those observed in metallic eutectics; these distributions are illustrated. (auth)

18373 DIFFUSION OF XENON IN CERAMIC OXIDES. David L. Morrison, Thomas S. Elleman, and Duane N. Sunderman (Battelle Memorial Inst., Columbus, Ohio). J. Appl. Phys., 35: 1616-22(May 1964).

Postirradiation measurements were made at 700 to 1500°C of the release of ^{133}Xe recoiled into single-crystal α-Al_2O_3, BeO, MgO, and ZrO_2 crystals during neutron irradiation in contact with UO_2 powder. The release pattern from most of the specimens was identical: a high rate of loss of ^{133}Xe for several minutes followed by a slower release for which the cumulative fractional release was linear with the square root of the heating time. Diffusion coefficients for ^{133}Xe were calculated from the slope of the release curve following the initial release. The magnitudes of the diffusion coefficients above 1100°C for α-Al_2O_3, BeO, and MgO were nearly the same whereas the diffusion coefficients in ZrO_2 were ten to a hundred times larger. The activation energy for ^{133}Xe release from α-Al_2O_3 above 1100°C was 64 kcal/g-mole. The xenon release behavior was compared to anion diffusion in these oxides. (auth)

18374 PLASMA PROPERTY OF LIQUID METALS. C. P. Flynn (Univ. of Illinois, Urbana). J. Appl. Phys., 35: 1641(May 1964).

An inverse relation between the expansion coefficient and the surface free-energy of a liquid metal is shown to be brought about by the plasma interaction between the electron gas and the liquid lattice. (R.E.U.)

18375 ORIENTATION OF VACUUM-DEPOSITED Be THIN FILMS. R. R. Verderber (Burroughs Corp., Paoli, Penna.). J. Appl. Phys., 35: 1643-4(May 1964).

Beryllium was vacuum-deposited on amorphous glass and single-crystal substrates of NaCl, mica, and CaF_2 over a range of substrate temperatures from 100 to 400°C at a rate of either 5 or 10 Å/sec. The crystalline structure of the films was examined by electron-diffraction technique. Highly oriented Be thin films were obtained as thick as 1500 Å. (R.E.U.)

18376 FULFILLING REQUIREMENTS FOR MATERIALS FOR NUCLEAR POWER PROJECTS. S. S. Smith, T. F. Pearson, and R. B. Hyde. J. Brit. Nucl. Energy Soc., 3: 59-64(Jan. 1964).

The attitude and work of the engineer in developing materials for nuclear power projects are discussed. Special attention is given to non-ferrous metals, steel, and concrete. An attempt was made to indicate some of the difficulties that have faced the steelmaker in the achievement of satisfactory specification levels in steel plates for use in nuclear power plants. The acceptance of properties of these materials is stressed. (P.C.H.)

18377 TRANSPORT NUMBERS IN STABILIZED ZIRCONIA. D. T. Bray and U. Merten (General Atomic Div., General Dynamics Corp., San Diego, Calif.). J. Electrochem. Soc., 111: 447-52(Apr. 1964).

A simple theoretical treatment of conduction in solids shows that apparent electron transport numbers determined by different experimental techniques are not identical. The techniques considered for stabilized zirconia were oxygen-transfer measurements and emf measurements on galvanic cells having oxygen at two different activities at the electrodes. Transport numbers for stabilizing cations can be determined by measuring compositional changes that result from passage of an electric current through the electrolyte. The principal current carrier in stabilized zirconia is known to be the oxide ion. The apparent electron transport number in an yttria-stabilized zirconia at 900–1100°C was found to be ≤0.005 in an oxidizing atmosphere and ≤0.011 in a reducing atmosphere. The apparent transport number for yttrium ions was found to be $\leq 4 \times 10^{-9}$. (auth)

18378 ELECTRON MICROSCOPIC AND ELECTRON DIFFRACTION STUDIES ON HYDROUS THORIUM OXIDE. W. O. Milligan and Yoshi Arai (Rice Univ., Houston, Tex.). J. Electronmicroscopy (Tokyo), 12: No. 2, 92-8(Dec. 1963).

Hydrous thorium oxide was prepared by the addition of ammonium hydroxide to solutions of thorium chloride (Series A) and thorium nitrate (Series B), followed by dialysis for varying periods of time at room temperature. It was also prepared by hydrolysis at 100° of thorium chloride solutions (Series C) and thorium nitrate solutions (Series D), followed by dialysis at 100° for varying periods of time. Samples from Series A and B were found by electron diffraction to be essentially amorphous, the diffraction pattern consisting of a few broad bands, in agreement with earlier work. Primary particles in the range 8 to 20 Å were observed on electron micrographs, the size increasing slowly with time of dialysis and aging. Samples from Series C and D were also found to be essentially amorphous at first, but the electron diffraction patterns became sharper and identical with that from normal cubic ThO_2 after several hours of hydrolysis and aging at 100°. Electron micrographs show a growth in crystal size to 200 to 400 Å as the hydrolysis and aging proceeds. A very small percentage of plate-like particles were detected by both electron microscopy and electron diffraction in samples for Series C. The number of such plate-like particles increased slightly with prolonged aging. The plates exhibited hexagonal crossgrating single-crystal type of electron diffraction pattern. They were not detected in samples prepared from the nitrate. Attempts to isolate the plates were unsuccessful. Their chemical composition is not known. Future work will involve hydrolysis in a high pressure bomb, to produce the plate-like material in larger amounts and to eliminate the possibility that the plates result from a recurring impurity. (from NSA of Japan)

18379 MICROSTRAINING IN POLYCRYSTALLINE NIOBIUM. T. J. Koppenaal and P. R. V. Evans (Illinois Inst. of Tech., Chicago). J. Inst. Metals, 92: 238-41 (Apr. 1964).

The early stage of plastic deformation in polycrystalline niobium at room temperature was investigated using a strain sensitivity of 1×10^{-6}. Variables studied include grain size, prestraining, and strain-aging. In the annealed or locked dislocation condition, the 1×10^{-6} yield stress is 11.2-15.6 kg/mm^2, depending upon the annealing treatment, while this yield stress is only 3.2-3.6 kg/mm^2 for specimens in the prestrained or unlocked dislocation condition. Observations of slip lines and dislocation etch pits in the microstrain region of annealed specimens indicate that grain-to-grain deformation occurs readily before the upper yield-point stress is reached. (auth)

18380 THE EFFECTS OF ZIRCONIUM IN TITANIUM-BASE ALLOYS. D. N. Williams, R. A. Wood, R. I. Jaffee, and H. R. Ogden (Battelle Memorial Inst., Columbus). J. Less-Common Metals, 6: 219-25(Mar. 1964).

The results of studies on the effects of Zr on room temperature mechanical properties when substituted for a portion of the titanium content in selected alpha, alpha-dispersoid, alpha-beta, and beta-Ti alloys are discussed. Zr was found to have a mild strengthening effect in Ti and in a variety of Ti alloys, but it appears to have quite limited usefulness as a strengthening addition. Modification of alpha-dispersoid, alpha-beta, or beta alloys with Zr did not appear to result in any significant improvements in the alloys. Data are tabulated. (P.C.H.)

18381 THE COMPOSITION AND STRUCTURE OF TECHNETIUM NITRIDE AND TECHNETIUM BORIDES. W. Trzebiatowski and J. Rudzinski (Technical Univ., Wroclaw, Poland and Inst. of Physical Chemistry, Polish Academy of Sciences, Poland). J. Less-Common Metals, 6: 244-5(Mar. 1964).

Analysis of Tc heated in nitrogen in the temperature range 400-900°C revealed no change in the lattice constants of the metal. When heated in ammonia in the range 700-1100°C, lattice constants increased to an extent depending on the amount of nitrogen absorbed. At 900-1100°C a new fcc phase was detected with a lattice constant varying from 3.980 to 3.985 A, according to nitrogen content. Tc-B alloys were prepared by mixing powdered Tc and powdered crystalline B (99%) pressing into pellets, and sintering in vacuo at 1100-1200°C for 120-200 hr. Data are given for Tc_3B, Tc_7B_3, and TcB_2. (P.C.H.)

18382 ELASTICITY OF TANTALUM SINGLE CRYSTALS. C. S. Hartley (Ohio State Univ., Columbus). J. Less-Common Metals, 6: 245-8(Mar. 1964).

It was demonstrated that the thin rod resonance technique applied to Ta single crystals of known orientation gives values of the single crystal elastic constants that are comparable to those obtained by other resonance techniques and by the pulse-echo technique. The thin rod resonance technique, although it requires a rather large number of specimens to obtain good statistical precision, requires somewhat less rigorous attention to such factors as specimen orientation, preparation of planar surfaces, and measurement of specimen length, all of which are essential in obtaining results of comparable precision using other techniques. (P.C.H.)

18383 TRANSMISSION ELECTRON MICROSCOPY OF OMEGA PHASE IN A Zr-15% Nb ALLOY. J. O. Stiegler, J. T. Houston, and M. L. Picklesimer (Oak Ridge National Lab., Tenn.). J. Nucl. Mater., 11: 32-40(Jan. 1964).

Transmission electron microscopy has been used to follow the formation and reversion of the metastable ω phase in a Zr-15% Nb alloy. In a fully aged specimen the ω phase is shown to consist of noncoherent platelets approximately 1000 Å in diameter and approximately 200 Å thick lying on {111} planes of the retained β phase. The platelets form a regular three-dimensional network having an average spacing of approximately 1000 Å. The retained β-phase regions contain a line structure similar to that observed in specimens aged at lower temperatures when the ω phase is coherent. Aging of the foils in the electron microscope resulted in partial reversion of the noncoherent platelets and formation of the coherent structure. Possible mechanisms for the formation of the two types of ω phase are discussed along with an explanation of the changes in mechanical properties that accompany their formation. (auth)

18384 DETERMINATION OF α-ALUMINUM SOLID SOLUBILITY LIMITS IN THE ALUMINUM-URANIUM AND ALUMINUM-PLUTONIUM SYSTEMS. P. R. Roy (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Nucl. Mater., 11: 59-66(Jan. 1964).

The α-aluminum solid solubility limits in the aluminum-uranium and aluminum-plutonium systems have been determined by metallographic methods. The maximum solid solubilities of uranium in aluminum and of plutonium in aluminum were found to be 0.06 ± 0.02 wt % U and 0.05 ± 0.02 wt % Pu respectively at the corresponding eutectic temperatures. The α Al-UAl_4 and α Al-$PuAl_4$ eutectic temperatures have been established by thermal analysis as 646 ± 0.5°C and 650 ± 0.5°C respectively. At 350°C, the solid solubility decreased to less than 0.04 wt % U in the Al-U system and to less than 0.025 wt % Pu in the Al-Pu system. (auth)

18385 METASTABLE PHASES IN THE URANIUM–NIOBIUM ALLOYS. M. Anagnostidis, M. Colombié, and H. Monti (C.E.R.C.A., Bonneuil/Marne, France). J. Nucl. Mater., 11: 67-76(Jan. 1964). (In French)

Uranium–niobium alloys containing 0.3 to 17.3 at.% Nb were quenched from the γ phase field and the resulting structures examined by micrography and x-ray diffraction. For solute contents below 8.8 at.% the α, α_a', and α_b' phases were successively observed. All these are orthorhombic, and the lattice parameters, as well as hardness values, were determined as a function of composition. In the range 8.8 to 15.7 at.% Nb, an α_b'' phase was formed; this is monoclinic, derived from the orthorhombic system by a variable angle β, which increases regularly from 90° as a function of the niobium content. Beyond 15.7 at.% Nb, tetragonal γ_d^0 is formed. Comparison of water, oil, and argon quenches showed the pronounced influence of quenching rate. The succession of metastable phases observed is qualitatively the same as in the U/Mo system; however, composition ranges were systematically displaced towards higher solute contents in the U/Nb system. The formation of some of these martensitic phases is satisfactorily explained in terms of a shear of the cubic phase in $\{112\}\gamma$ along the (111) γ directions. The behavior of Mo, Nb, and Zr as solutes is interpreted in terms of the atomic diameters of these elements. However, the origin of the α_a' phase could not be determined. (auth)

18386 XENON DIFFUSION IN UO_2. SOME COMPLICATING FACTORS. J. R. MacEwan and W. H. Stevens (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Nucl. Mater., 11: 77-93(Jan. 1964).

The release of fission xenon from UO_2 has been studied during post-irradiation annealing at 1400°C. Both single-crystal powders and sintered material were employed; suitable precautions were taken to ensure stoichiometric composition. In other post-irradiation experiments the release of xenon from single-crystal-powder specimens was followed during pulverization. The releases during annealing were analyzed by the diffusion equation, $f = \sqrt{(4\,Dt/\pi)}S/V$. The resulting diffusion coefficients decreased with increasing irradiation exposure. This decrease was most rapid in the range 10^{16} to 10^{17} fissions/cm^3 and had apparently saturated for the sintered material by 10^{19} fissions/cm^3. Anneals of long duration were performed on single-crystal specimens irradiated to exposures from 8.5×10^{14} to 3.0×10^{17} fissions/cm^3. The diffusion coefficients appeared to decrease abruptly during the period 8 to 24 hours after the start of an experiment. A constant lower value was then indicated for the following period of 3 to 7 days. The diffusion results are interpreted in terms of a distribution of existing, and irradiation-induced, trapping sites on a submicron scale. Pulverizing experiments with single-crystal specimens support the existence of the irradiation induced trapping sites. The interpretation leads to an upper limit of 3×10^{-9} (xenon atoms/uranium atom)/atm. xenon for the solubility of xenon in the UO_2 lattice at 1400°C. (auth)

18387 γ LATTICE PARAMETERS IN U–Mo–Nb ALLOYS. S. Maxwell, E. F. Tate, D. G. Harris, and J. J. Stobo (International Research and Development Co. Ltd., Newcastle-upon-Tyne, Eng.). J. Nucl. Mater., 11: 119-20(Jan. 1964).

Ternary alloys containing up to 30 at.% Mo and 40 at.% Nb with U are studied, and their lattice parameters are measured. (T.F.H.)

18388 STRUCTURE DETERMINATION OF SOME PHASES IN THE SYSTEMS: Zr–Al–Si AND Hf–Al–Si ($ZrAl_2Si$); Zr Si(Al), Hf(Si,Al); Zr_3Si_2; Hf_3Si_2). O. Schob, H. Nowotny, and F. Benesovsky (Universität, Vienna). Monatsh. Chem., 92: 1218-26(1961). (In German)

Powder mixtures were pressed cold and then allowed to react under Ar at ca 1200°C. The products were powdered and pressed cold again, then homogenized for 4 to 12 hr under Ar at 1200°C. The $ZrAl_3$ structure was confirmed (a = 4.01, c = 17.27 kX.E); Si-containing alloys $Zr(Al,Si)_3$ rich in Al are of the $TiAl_3$ structure; a = 5.509, c = 8.990 kX.E, c/a = 1.632; a powder pattern is tabulated. In the system Zr–Si the region formerly indicated as U(II) was identified as a monosilicide of the CrB type, stabilized by Al. The cell constants vary from a = 3.754 to 3.780, b = 9.89_2 to 10.05_0, c = 3.746 to 3.78 kX.E, the higher values corresponding to $Zr(Al_{\sim 0.3}Si_{\sim 0.7})$; a representative powder pattern is tabulated. Al/Si substitution in this system leads to pseudo-tetragonal symmetry, as in $Ti(Al,Si)_2$. A similar case arises (powder pattern table given) with $Hf(Al_{\sim 0.5}Si_{\sim 0.5})$; the constants for this case, similar to CrB again, are a = 3.707, b = 9.87_0, c = 3.746 kX.E. Tables are also given for powder patterns of Zr_3Si_2 and Hf_3Si_2. These have the U_3Si_2 structure and the following lattice constants: Zr_3Si_2, a = 7.068, c = 3.707 kX.E, c/a = 0.5245; Hf_3Si_2, a = 6.986, c = 3.664 kX.E, c/a = 0.5245. (BBB)

18389 THE CRYSTAL STRUCTURE OF Zr_2Al AND Hf_2Al. H. Nowotny, O. Schob, and F. Benesovsky (Universität, Vienna). Monatsh. Chem., 92: 1300-3(1961). (In German)

Alloys were prepared by homogenizing samples for 6 to 12 hr at 1200°C under Ar. No Zr_3Al with a Cu_3Au structure was detected. In addition to α-ZrAl with parameters a = 3.25_0, c = 5.16_5 kX.E, c/a = 1.59_0, another phase similar to $CuAl_2$, Zr_2Al, was found. The powder pattern tabulated indicates a tetragonal cell with a = 6.84_0, c = 5.49_0 kX.E, c/a = 0.8027, shown to agree by line intensities with Zr_2Si. Only a small region of homogeneity was found for Zr_2Al. The cell diminishes with increasing Al content. In α-Zr(Al) the structure is evidently the intercalation type, since the parameters are larger than in pure α-Zr. In the ternary mixture Zr–Al–Si a continuous mixed crystal formation occurs between Zr_2Al and Zr_2Si; change in lattice parameters with composition are tabulated. The existence of Zr_3Al, Zr_5Al_3 (D 8_8), and Zr_2Al_3 was confirmed, but Zr_5Al_3 (T 1), Zr_4Al_3, and Zr_2Al (NiAs) could not be found. In Hf–Al alloys prepared in the same manner, Hf_2Al was found in addition to α-Hf and α-Hf(Al). It has cell constants a = 6.76_2, c = 5.37_4, c/a = 0.794_9, and the cell is thus smaller than in Zr_2Al. The region of homogeneity is narrow. Mixed crystal formation exists between Hf_2Al and Hf_2Si; the lattice parameters of mixtures are tabulated. No evidence for the existence of ZrAl was found, but HfAl appears to be rather stable. (BBB)

18390 THE PHASE $ScBe_{13}$. E. Laube and H. Nowotny (Universität, Vienna). Monatsh. Chem., 93: 681-3(1962). (In German)

Samples of Sc and Be were sintered at 1250°C, the regulus powdered and resintered; powder patterns of a sample with 0.5 at. % Sc indicated, in addition to Be, a phase of the type $NaZn_{13}$. A sample of the proper composition was homogeneous; the evaluation of its powder pattern is tabulated and agrees with a formulation $ScBe_{13}$. The lattice constant is 10.08_2 kX.E; this differs only slightly from the constant for $ZrBe_{13}$, 10.024 or 10.027. Samples were prepared by the same method corresponding to YBe_{13}, $LaBe_{13}$, and $CeBe_{13}$. These had constants equal to 10.23_0,

10.43_6, and 10.35_7 kX.E respectively, in good agreement with other published data. A very small region of homogeneity was observed; possible influence of O on the lattice constant is unknown. The compounds have a polyhedral structure, the A-partner having a coordination number of 24; this large value may be associated with the great difference in the radii r_A and r_B. Thus (Mg, Ca, Sc, Y, La, Ce, Zr, Hf, Th, U, Pu)Be_{13}, (Na, Sr, Ba)Zn_{13}, and (K, Rb)Cd_{13} exist, but compounds that would contain Mg as B-partner do not exist because of its larger radius. (BBB)

18391 THE STRUCTURE OF $NbSn_2$. A. H. Gomes de Mesquita, C. Langereis, and J. I. Leenhouts. Philips Res. Rept., 18: 377-82(Oct. 1963).

The crystal structure of $NbSn_2$ is of the $CuMg_2$-type. On the basis of single-crystal x-ray-diffraction data accurate atomic positions and interatomic distances were determined. Data are tabulated. (auth)

18392 INDUCED FERROMAGNETISM IN EuTe AND GdP. G. Busch, (Eidgenössische Technische Hochschule, Zurich), P. Junrod, P. Schwob, O. Vogt, and F. Hulliger. Phys. Letters, 9: 7-8(Mar. 15, 1964).

Magnetic fields up to 120 k oersteds were used to induce ferromagnetic spin arrangements in normally antiferromagnetic EuTe and GdP. Ferromagnetic saturation was reached in EuTe and GdP at ~75 and 90 k oersteds, respectively. (C.E.S.)

18393 PHASE TRANSFORMATION IN SAMARIUM INDUCED BY HIGH PRESSURE AND ITS EFFECT ON THE ANTIFERROMAGNETIC ORDERING. A. Jayaraman and R. C. Sherwood (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 134: A691-2(May 4, 1964).

Samarium undergoes a pressure induced phase transformation to double-hexagonal close-packed (La-type) structure at pressures around 40 kbar and temperatures near 300°C. It is retained metastably at atmospheric pressure. The new phase has a Néel temperature of 27°K as compared to 14.8°K noted for normal form of Sm. Pressure induced phase transformations observed in Gd, Sm, Ce, and La suggest that the sequence of polymorphic transformations under pressure in trivalent rare earths is in the order hcp → Sm-type → dhcp → fcc. (auth)

18394 LATTICE DYNAMICAL STUDIES USING ABSOLUTE MEASUREMENTS OF THE LAMB-MÖSSBAUER RECOIL-FREE FRACTION. W. A. Steyert and R. D. Taylor (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 134: A716-22(May 4, 1964). (LADC-6143)

Absolute values of the recoil-free fraction f of the 14.4-kev γ rays of ^{57}Fe are reported at temperatures from 4 to 1050°K. ^{57}Co, the parent of ^{57}Fe, is a dilute impurity in Au, Cu, Ir, Pd, Pt, Rh, and Ti. For intermediate temperatures the measured f is consistent with the calculations of Visscher, and Maradudin and Flinn when the impurity-host coupling constant is taken to be about the same as the host-host coupling constant. At the highest temperatures, the f's of Au, Cu, and Pd fall off faster than simple theory would predict due to diffusion and anharmonicities. The results are compared with the anharmonic lattice theory of Maradudin and Flinn. Chemical and temperature-shift data are also reported. (auth)

18395 ON THE RELATION OF SOME PROPERTIES OF CARBIDES AND NITRIDES OF TRANSITION METALS WITH THEIR ELECTRON STRUCTURE. Z. I. Tolmacheva and V. N. Eremenko (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Poroshkovaya Met., Akad Nauk Ukr. SSR, No. 6, 18-23(Nov.-Dec. 1963). (In Russian)

It is shown that in carbides and nitrides of transition metals (penetration phases), along with collectivized electrons, the bond is very substantially strengthened by the overlap of the electronic shells of ions. On the basis of the conception of the polarization of bonds, an explanation is given for the effect of the embrittlement of metals by admixtures and the nature of the brittleness of some penetration phases. (auth)

18396 STATE DIAGRAM OF THE Y_2O_3–MgO SYSTEM. L. M. Lopato and S. G. Tresvyatskii (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 6, 32-5(Nov.-Dec. 1963). (In Russian)

The method of annealing and hardening was used to investigate the state diagram of the Y_2O_3–MgO system. It was found that this system is eutectic with coordinates of the eutectic point of 52 mole % MgO and a melting point of 2080 ± 30°C. (auth)

18397 MECHANICAL PROPERTIES OF MOLYBDENUM PRODUCED IN A VACUUM FURNACE WITH CONSUMABLE ELECTRODE. E. Josso, J. M. Henry, J. Gugenheim. Rev. Met. (Paris), 60: 797-805(Sept. 1963). (In French)

In order to reduce embrittlement and anisotropy, it is convenient to treat the metal at the lowest possible temperature consistent with the required degree of softness. If embrittlement remains excessive, it may be advantagecus to hold the metal for a short time at 300°C in air, but susceptibility to tri-axial stresses continues to be present. (auth)

18398 ALLOTROPY IN SOME RARE-EARTH METALS AT HIGH PRESSURES. G. J. Piermarini and C. E. Weir (National Bureau of Standards, Washington, D. C.). Science, 144: 69-71(Apr. 3, 1964).

Allotropes of La, Ce, Pr, and Nd were observed at elevated pressures with an x-ray diffraction camera which incorporates a diamond-anvil, high-pressure cell. In each case a high-pressure modification was observed which has a face-centered cubic structure. At room temperature the unit cell dimensions (a_0) for the high-pressure fcc structures and approximate pressures at which they were determined are as follows: La, 5.17 Å (23 kb); Ce, 4.82 Å (15 kb); Pr, 4.88 Å (40 kb); and Nd, 4.80 Å (50 kb). The unit cell dimensions for the high-pressure forms of La, Pr, and Nd apparently have never been reported. (auth)

18399 CRYSTAL STRUCTURES OF COMPOUNDS OF RARE-EARTH METALS WITH BERYLLIUM (RBe_{13}). E. I. Gladyshevskii, P. I. Kripyakevich, and D. P. Frankevich (L'vov State Univ.). Soviet Phys.-Cryst. (English Transl.), 8: 628-9(Mar.-Apr. 1964).

The crystal structure of compounds of La, Ce, Pr, Nd, Sm, Eu, Tb, Dy, Ho, Er, Tm, Yb, and Lu with Be was investigated by x-ray diffraction. (C.E.S.)

18400 INFLUENCE OF URANIUM ADDITIONS ON IRON AND STEEL. I. URANIUM ADDITIONS TO LOW-CARBON STEELS. M. Hasegawa and I. Onoda (Waseda Univ., Japan). Tetsu To Hagane, 48: 1438-9(1962). (In Japanese)

The effect of uranium additions of 0.06–0.3% upon 0.05–0.37% plain carbon steels was investigated. Al was used as a deoxidant, and the recovery of U was less than 40% when the amount of Al added was small, but increased with C content in the case of metallic uranium. The U additions appeared to refine the austenite grain. Nonmetallic inclusions were found in the steel; no conclusions were drawn as to segregation because of the small size of the ingots. After annealing, U-containing steels lost their purely fer-

ritic grain structure with precipitation of a carbide believed to be UC. The amount of carbide increased with increasing U. Temperature tests showed that only a small amount of U goes into solid solution in the high-temperature austenite range. As far as solubility in the ferrite area is concerned, no change was found in the hardness and structure and no precipitation was observed. No improvement in hardenability was found at 870°C with uranium additions. No effects were found on tensile strength and notch impact strength. (Uranium Abstr., 3: March 1964)

18401 INFLUENCE OF URANIUM ADDITIONS ON IRON AND STEEL. III. URANIUM ADDITIONS TO LOW-ALLOY, HIGH-STRENGTH STEELS. M. Hasegawa and I. Onoda (Waseda Univ., Japan). Tetsu To Hagane, 49: 1541-3(1963). (In Japanese)

An investigation was made on the nature of effect of uranium on high-strength, low alloy steels, with special reference to cleanliness, hardenability, and transition temperature. (Uranium Abstr., 3: March 1964)

18402 ON THE EFFECT OF URANIUM ADDITIONS ON THE BEHAVIOR OF CARBON AND SULFUR IN AUSTENITIC STAINLESS STEELS. I. STUDIES ON THE BEHAVIOR OF URANIUM IN AUSTENITIC STAINLESS STEEL. M. Kawabata, K. Yokota, T. Watanabe, and K. Ebata (Nippon Metal Industry Co. Ltd., Japan). Tetsu To Hagane, 49: 1543-5 (1963). (In Japanese)

A study was made on the effects of uranium in austenitic stainless steel, with special reference to hot workability impaired by sulfur, and to transgranular corrosion stemming from carbon precipitated as chromium carbide. (Uranium Abstr., 3: March 1964)

18403 THE ANNEALING BEHAVIOR OF EXPLOSIVELY SHOCKED TUNGSTEN AND COLUMBIUM. M. J. Klein and F. A. Rough (Battelle Memorial Inst., Columbus, Ohio). Trans. Am. Soc. Metals, 57: 86-93(Mar. 1964).

The structural changes induced in tungsten and niobium by explosively shocking them and by explosively shocking and annealing them is reported. The hardness increase from explosive impacting and the softening kinetics is independent of the twin densities after shocking within the limits of the program. Although recrystallization is induced by annealing the shocked structures, softening can occur without visible recrystallization. When recrystallization was induced after shocking and annealing, large grained structures resulted, indicating a low nucleation rate. Such recrystallization is sometimes incomplete in niobium and reaches only about 30% completion in tungsten for the conditions of test. A hardness increase suggestive of an age-hardening process is induced in niobium as a result of shocking and annealing. (auth)

18404 THE METASTABLE CONSTITUTION OF QUENCHED TITANIUM AND ZIRCONIUM-BASE BINARY ALLOYS. C. A. Luke (Lockheed Aircraft Corp., Sunnyvale, Calif.), R. Taggart, and D. H. Polonis. Trans. Am. Soc. Metals, 57: 142-9(Mar. 1964).

The metastable constitution of titanium and zirconium-base binary alloys was examined from a theoretical point of view and correlated with existing experimental data. The electron-atom ratio was deduced as a criterion for predicting 100% beta stabilization in quenched alloys. The same criterion also establishes the range over which omega phase is expected to form in conjunction with either alpha-prime or beta. The theory enables quantitative predictions to be made regarding the effects of minor concentrations of contaminants on the constitution of binary alloys. (auth)

18405 TRANSFORMATION CHARACTERISTICS OF U–Mo AND U–Mo–Ti ALLOYS. P. E. Repas, R. H. Goodenow, and R. F. Hehemann (Case Inst. of Tech., Cleveland). Trans. Am. Soc. Metals, 57: 150-63(Mar. 1964).

Isothermal transformation kinetics are described for four uranium-base alloys: U–8 Mo, U–10 Mo, U–8 Mo–½ Ti, and U–8 Mo–1 Ti. The time-temperature-transformation (TTT) diagrams presented are based on metallographic, dilatometric, microhardness, and x-ray-diffraction data. For the alloys under investigation, the transformation behavior may be divided conveniently into high- and low-temperature regions. At high temperatures the metastable bcc gamma phase decomposed by either a cellular mechanism or by a combination of cellular and Widmanstätten mechanisms. Isothermal transformation at low temperatures involved a different mechanism or mechanisms, but the transformation structures could not be revealed metallographically. X-ray-diffraction and hardness measurements were utilized to follow the course of transformation at these temperatures. Decomposition in the low-temperature range was initiated by precipitation of γ' homogeneously throughout the γ matrix. (auth)

18406 SUSCEPTIBILITY OF ZIRCONIUM AND ZIRCONIUM ALLOYS TO DELAYED FAILURE HYDROGEN EMBRITTLEMENT. D. Weinstein and F. C. Holtz (Illinois Inst. of Tech., Chicago). Trans. Am. Soc. Metals, 57: 284-93(Mar. 1964).

The susceptibility of zirconium and certain zirconium alloys to delayed failure (static fatigue), as caused by a combination of absorbed hydrogen and applied stress, was determined. Specimens of unalloyed zirconium, Zircaloy-2, Zr–1.25 Al–1 Sn–1 Mo, and Zr–2.5 Nb were hydrogenated in a Sieverts apparatus and evaluated in static tests at room temperature. For unnotched and notched specimens of unalloyed zirconium and Zircaloy-2 containing up to 500 ppm hydrogen, no time-dependent, brittle fractures occurred that could be attributed to the delayed failure phenomenon. The high-strength Zr–Al–Sn–Mo alloy with 500 ppm hydrogen, however, exhibited a high degree of susceptibility to delayed failure at room temperature. Data for heat treated Zr–2.5 Nb containing 500 ppm hydrogen indicated that this material is moderately susceptible to delayed failure. The results are explained in terms of dislocation pile-up at hydride platelets and the ability of these matrices to allow crack propagation. (auth)

18407 WORK HARDENING OF BERYLLIUM WIRE. A. G. Gross, Jr. (North American Aviation, Inc., Anaheim, Calif.). Trans. Am. Soc. Metals, 57: 355-6(Mar. 1964).

Results of wire-drawn prestrain tests on Be wires at 450°C are tabulated. An average value of the strain-hardening exponent was calculated as n = 0.323. (P.C.H.)

18408 PLASTIC DEFORMATION OF SINGLE CRYSTALS OF MOLYBDENUM. Pang-hsin Chou. Wu Li Hsueh Pao, 19: 285-96(1963).

An investigation was conducted on 24 single crystals of Mo of various orientations after stretching at −80, −50, +27, +1000, and +2000°C. It was established from the data of metallographic and x-ray-diffraction analyses that traces of slip {112}{123}{145} etc., can be interpreted as paired slip in two nonparallel planes {110} along almost the same direction ⟨111⟩. The external appearance of the traces of slip depends on the orientation of the single crystal. At various temperatures, the appearance of the traces of slip may differ for samples with the same orientation. (OTS)

18409 MICROSTRUCTURE OF STABILIZED ZIRCONIA AND SOME CONSIDERATIONS ABOUT PARTIAL STABILIZATION OF ZIRCONIA. Kenya Hamano and Hisao Yamada (Tokyo Inst. of Tech.). Yogyo Kyokai Shi, 71: 224-31(Dec. 1963). (In Japanese)

Microstructures of partly stabilized and perfectly stabilized zirconia were examined by means of a polarization microscope and x-ray diffraction. A mechanism for the partial stabilization of zirconia was inferred using the phase diagram of the binary system $CaO-ZrO_2$. The partly stabilized zirconia is an aggregate of 1000- to 1500-μ massive grains, which consist of birefringent optically anomalous cubic zirconia, 5 to 10 μ in diameter, and monoclinic zirconia, 6 to 10 μ in diameter, all arranged nearly parallel to some crystallographic direction. Stabilized zirconia consist of cubic zirconia and small amounts of monoclinic zirconia with a few melilite-group minerals deposited in it. The lime content of the partly stabilized sample is lower than that of the stabilized zirconia, but lime solubility in the cubic zirconia seems to be much larger in the former than in the latter. It was concluded that the main process in the partial stabilization of zirconia was the evolution of tetragonal zirconia into cubic and monoclinic modifications. Equilibrium is very difficult to reach and is governed strongly by cooling conditions. The faster the cooling rate, the larger the deviation from the equilibrium and the lower the solubility of lime into the cubic zirconia formed. Therefore, although the properties of partially stabilized zirconia can be controlled with cooling conditions, the zirconia grains seem to contain some unstable parts. This creates some problems in the use of partially stabilized zirconia and of lime as the stabilizer of cubic zirconia. (from NSA of Japan)

Radiation Effects

18410 (AD-416313) COMPUTER PROGRAMS FOR THE TWO-BODY APPROXIMATION TO THE RADIATION DAMAGE PROBLEM (thesis). John P. Bird and Ronald L. Kronz (Naval Postgraduate School, Monterey, Calif.). 1963. 178p.

A binary collision simulation of the radiation damage problem is proposed. Energy thresholds and parameter adjustment are discussed. Preliminary results show strong focusing in the (110) direction and weaker focusing in the (100) direction. Although not complete, the model is expected, with suggested modifications, to adequately represent the radiation damage problem. (auth)

18411 (AE-138) RADIATION-INDUCED PRECIPITATION IN IRON. B. Solly (Aktiebolaget Atomenergi, Stockholm). Feb. 1964. 9p.

Foils of iron have been neutron-irradiated in the Swedish research reactor R2 to integrated doses in the range 10^{17} to 10^{19} nvt (>1 Mev) and examined by transmission electron microscopy. Features have been observed having diffraction contrast similar to that of the prismatic dislocation loops formed in fcc metals by the collapse of point-defect clusters. The features have been shown to be due to precipitation of impurities at radiation damage centers in the iron matrix. (auth)

18412 (CRFD-1164) THE FIRST EXPERIMENTAL IRRADIATION OF FOG-COOLED FUEL. J. G. Collier, A. D. Lane, R. D. Page, and E. E. Winter (Atomic Energy of Canada Ltd., Ottawa). July 1963. 35p. (Exp-NRX-42106; CONF-309-4)

From EAES Symposium on Two Phase Flow Steady State Burnout and Hydrodynamic Instability, Studsvik, Sweden, Oct. 1963.

The first experimental irradiation of nuclear reactor fuel with fog cooling is described. Tests done during the irradiation to determine the "dryout heat flux" (critical heat flux for high quality boiling) at various flow conditions are also outlined. The results of this irradiation are compared with results from out-of-reactor experiments. The irradiation was undertaken in a fuel irradiation facility called the X-4 loop, which is cooled by a high pressure steam/water mixture. The fog coolant in this loop is generated by spraying slightly sub-cooled water into steam with a small degree of superheat at the same pressure. The fuel assembly contained two 15 mm diameter fuel elements, one sheathed in Zircaloy-2, the other sheathed in stainless steel to permit the attachment of sheath thermocouples. The irradiation was run for 17 days under conditions approximating those anticipated in a fog cooled power reactor. During most of this period, an outlet quality of approximately 31 wt % steam was used with a mass velocity of 100 g/cm^2 sec at a pressure of 70 kg/cm^2. Dryout tests were done at mass velocities from 107 to 117 g/cm^2 sec with outlet qualities ranging from 37 to 40 wt % steam, and heat fluxes up to 108 w/cm^2. Dryout was detected by sheath thermocouples on the stainless steel clad element. The results of these tests are in good agreement with a model based on a series of out-of-reactor tests. (auth)

18413 (EURAEC-975) THE EFFECT OF RADIATION ON THE DUCTILE-BRITTLE TRANSITION IN PRESSURE VESSEL STEELS. Quarterly Report No. 12, October 1–December 31, 1963. E. Anderson, W. Bollmann, D. Brandon, D. King, M. Malone, and J. Spreadborough (Battelle Memorial Inst. International Div., Geneva). Jan. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 095-62-12-RDS. 40p.

The effects of certain solute elements on the flow stress behavior of Armco iron are reported and discussed. The arrangements for measuring the electrical resistivities of neutron irradiated samples are described, and some surface effects produced by the ion bombardment of Armco iron are briefly noted. (auth)

18414 (NP-13771) BARKHAUSEN EFFECT IN IRRADIATED PURE IRON AND NICKEL. Final Report. S. I. Taimuty and J. B. Swedlund (Stanford Research Inst., Menlo Park, Calif.). Feb. 28, 1964. Contract Nonr-3615(00). 42p.

The effect of electron and neutron irradiation on the Barkhausen effect and coercive force of pure iron and nickel were investigated. The investigation was designed to establish whether (1) the Barkhausen effect can provide a sensitive indication of the presence of large radiation-induced defect clusters (1 to 5×10^{-5} cm diameter) and whether (2) study of the Barkhausen effect could provide meaningful information about behavior of such defects. (These aims were based on the hypothesis that the Barkhausen effect arises from impedance of domain wall motion by defects having dimensions comparable to the domain wall thickness.) Pure iron and nickel samples procured from various sources were irradiated with 1.06×10^{18} or 3.63×10^{18} n/cm^2 (energies greater than 0.18 Mev) or with 3.55×10^{16} electrons/cm^2 (electron energy–26 Mev). Changes in coercive force at these exposure levels were within experimental error (±10 percent). Changes in the Barkhausen effect (number and size distribution) were also within experimental error (about 10 percent) with three exceptions in the 16 experiments. One pair of iron samples exhibited an increase of about 30 percent in the number of Barkhausen pulses larger than about 3×10^{-5} emu after 3.63×10^{18} n/cm^2. One pair of nickel

samples exhibited an increase of about 15 percent in pulses of about the same size after 1.06×10^{18} n/cm^2. One iron sample showed an increase of about 30 percent after electron irradiation, while a second identical sample showed essentially no change. The increase is anomalous, since electrons do not directly produce large defect clusters. The results indicate that the Barkhausen effect is a more sensitive indicator of radiation damage in magnetic materials than is the coercive force. However, the smallness of the effect after neutron irradiation is puzzling. Based on estimates of the number of high-energy primary recoils produced by neutrons, the observed changes were several orders of magnitude too small. This result may indicate that the concentration of defects generated in the path of high-energy primary recoils is too small to impede domain wall motion appreciably. (auth)

18415 (ORNL-TM-763) EXAMINATION OF UO_2 IRRADIATED AT HIGH TEMPERATURES. J. G. Morgan, M. F. Osborne, and L. Long, Jr. (Oak Ridge National Lab., Tenn.). Mar. 1964. Contract W-7405-eng-26. 32p.

The postirradiation examination of UO_2 which operated at temperatures above 4000°F for burnups from 87 to 8,410 Mwd/mt UO_2 shows a more or less expected change in grain structure. The fission gas release was nearly 100% in all cases. (auth)

18416 (REIC-ACCESS-72) MONTHLY ACCESSION LIST [ON RADIATION EFFECTS DATA]. Abstracts No. 22585 to 22668. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Mar. 10, 1964. Includes MONTHLY ACCESSION LIST COORDINATE INDEX. Accession Lists from October 1, 1963 to February 29, 1964. Contract AF33(615)-10085. 43p. (AD-432342)

A total of 84 abstracts are presented of articles which are accessioned and extracted for the REIC Technical Information File during the period Feb. 1 to Feb. 29, 1964. The abstracts are arranged under the headings metallic materials, ceramic materials, organic materials, polymeric materials, inorganic materials, electronics, facilities, space environment and effects, experimental devices and techniques, and miscellaneous. (D.L.C.)

18417 (ANL-Trans-3) STRENGTHENING OF NEUTRON-IRRADIATED COPPER CRYSTALS. II. DEPENDENCE OF INDIVIDUAL CHARACTERISTICS OF THE STRESS-STRAIN CURVE ON IRRADIATION DOSE, DEFORMATION TEMPERATURE AND DEFORMATION RATE. Armin Ruckwied (Max-Planck-Institut fur Metallforschung, Stuttgart). Translated by Lydia Venters (Argonne National Lab., Ill.). 1964. 33p.

For publication in Z. Metallk., 55: (1964).

The dependence of the characteristic values of individual strengthening regions (initial and end points, and strengthening coefficients) on the irradiation dose, deformation temperature, and deformation rate in copper crystals is discussed in detail. These dependences reflect in part very clearly the differences between the individual curve types. Thus, the plastic-range length a_F in the type A1 increases with the irradiation dose, remains constant in the type A2, and increases with varying intensity in the types B and D when the dose is increased. In the type A, a_F decreases with increasing deformation temperature, but increases with deformation temperature in the type C. (P.C.H.)

18418 (EURAEC-971) RESEARCH INTO THE EFFECTS OF NEUTRON RADIATION ON THE PROPERTIES OF ALLOY ZrNb3Sn1. Quarterly Report No. 6, October 1, 1963–December 31, 1963. (Metallgesellschaft A. G., Frankfurt am Main). Jan. 24, 1964. Work Performed under United States–Euratom Joint Research and Development Program. 21p. (A translation)

An investigation was made into the effects of varying dosimetry on the mechanical properties and corrosion behavior of the Zr–Nb–Sn alloy. Hardness measurements and notched bar impact tests were made on the radiated samples. The hardness of the alloy and Zircaloy-2 rises as a result of a radiation dose of $3.5 \cdot 10^{19}$ n/cm^2 by about 15%; an increase to $9.2 \cdot 10^{19}$ n/cm^2 results in a further slight increase in hardness. The notched bar impact strength of the alloy is increased by radiation, and with Zircaloy-2 no great alteration is noted. Should the samples be annealed at 300 or 360°C after radiation, a decline in hardness is found with the Zircaloy-2, caused by a partial raising of the radiation intensity. In the case of Zr–Nb–Sn alloy the decline in the radiation hardening is accompanied by a further hardening through precipitation. The precipitation hardening processes are accelerated by the preceding radiation. The preparations for the corrosion tests under radiation were completed. (auth)

18419 KINETICS OF CARBON PRECIPITATION IN IRRADIATED IRON. II. ELECTRICAL RESISTIVITY MEASUREMENTS. F. E. Fujita and A. C. Damask (Brookhaven National Lab., Upton, N. Y.). Acta Met., 12: 331-9 (Apr. 1964).

The electrical resistivity changes that occur upon annealing quenched iron–carbon (0.011 wt%) after irradiation at low temperatures in a reactor are compared to the changes that occur in unirradiated specimens. In unirradiated specimens two stages of resistivity are noted, one at about 170°C, associated with the formation of a metastable carbide, and one at about 250°C, associated with the formation of Fe_3C. In contrast, five annealing stages are observed in the irradiated specimens between −80 and 300°C. These stages are discussed in terms of the migration history of the carbon atoms. It is concluded that the carbon atoms are temporarily trapped by radiation-produced point defects and leave the traps only at a temperature higher than that at which the metastable carbide can form. As expected, no resistivity decay process associated with the formation of the metastable carbide is observed in specimens irradiated to a dosage sufficient to trap all of the carbon atoms. (auth)

18420 KINETICS OF CARBON PRECIPITATION IN IRRADIATED IRON. III. CALORIMETRY. R. A. Arndt and A. C. Damask (Brookhaven National Lab., Upton, N. Y.). Acta Met., 12: 341-5(Apr. 1964). (BNL-7069)

Internal friction and electrical resistivity measurements associated with the removal of carbon from solution in iron indicate that in irradiated specimens the carbon is trapped at defects before it precipitates. The binding energy of carbon to these defect traps was measured by calorimetry and found to be 0.41 ev/atom. It is concluded, therefore, that no precipitate with a binding energy for carbon of less than 0.41 ev/atom will be formed in an iron–carbon alloy that was irradiated to a dosage sufficient to trap all of the carbon atoms. In unirradiated iron–carbon the energy released per carbon atom in forming the metastable carbide precipitate was found to be 0.27 ev/atom, which explains why this carbide is not formed in irradiated alloys. (auth)

18421 KINETICS OF CARBON PRECIPITATION IN IRRADIATED IRON. IV. ELECTRON MICROSCOPE OBSERVATIONS. H. Wagenblast (U. S. Steel Corp., Monroeville, Penna.), F. E. Fujita, and A. C. Damask. Acta Met., 12: 347-53(Apr. 1964). (BNL-7070)

Iron containing 0.011 wt % carbon in solution was irradiated at about −100°C in a reactor to a total dose of 4.5×10^{17} nvt (fast). The alloy was then annealed isochronally up to 330°C and the development of precipitate particles was observed by transmission electron microscopy at suitable temperature intervals and compared to the precipitation in unirradiated alloys. It was found that irradiation prevents the formation of the metastable carbide precipitate, which occurs about 160°C in the unirradiated alloy, but does not alter the temperature of the Fe_3C precipitation process. An accelerated growth of the Fe_3C precipitate particles occurs between 300°C and 330°C in the irradiated specimens. (auth)

18422 POINT DEFECT CONFIGURATIONS IN IRRADIATED IRON–CARBON ALLOYS. R. A. Johnson (Brookhaven National Lab., Upton, N. Y.) and A. C. Damask. Acta Met., 12: 443-5(Apr. 1964). (BNL-7519)

Point defect calculations were made using a high-speed computer to minimize the energy of an array of about 500 lattice atoms. Configurations of interstitial-carbon and vacancy-carbon complexes were obtained and estimates of the temperature of their formation and dissociation and of the expectation of internal friction arising from their reorientation were made. (R.E.U.)

18423 INFLUENCE OF γ-RAYS ON THE ELECTRICAL PROPERTIES OF GLASS DUST. Zygmunt Bodnar, Jozef Malcher, Anna Szaynok, and Walentyna Wolniewicz (Inst. of Tech., Wrocław, Poland). Acta Phys. Polon., 25: 57-60 (Jan. 1964).

Irradiation of glass with γ rays produces changes in the electrification of the dust. Short irradiation (100 minutes) increases whereas long irradiation diminishes the dust electrification. Dust of glass irradiated and heated shows a predominance of positive charge. The results obtained can be explained by the influence of irradiation on the structure of the material and by thermal excitation of electrons through heating. (auth)

18424 EFFECT OF FAST-NEUTRON-INDUCED DEFECTS ON THE CURRENT-CARRYING BEHAVIOR OF SUPERCONDUCTING Nb_3Sn. G. W. Cullen and R. L. Novak (RCA Labs., Princeton, N. J.). Appl. Phys. Letters, 4: 147-9(Apr. 15, 1964).

Samples of Nb_3Sn were irradiated with fast neutrons at 3.4×10^{17} and 6.6×10^{17} n/cm^2, and current-density measurements were compared with preirradiation measurements. The critical currents carried by the specimen are shown as a function of externally applied magnetic fields at 4.2°K and were found to increase with irradiation. The nature of the damage responsible for the changes is discussed. (R.E.U.)

18425 EFFECTS OF TYPE AND DENSITY OF DEFECTS ON YIELD STRENGTH OF NEUTRON-IRRADIATED Cu AND Cu–14 AT. % Al ALLOY. R. M. J. Cotterill and T. J. Koppenaal (Argonne National Lab., Ill.).. Appl. Phys. Letters, 4: 156-7(Apr. 15, 1964).

Annealed disks, 0.13-mm thick, of 99.999% Cu and Cu–14 at. % Al were irradiated by 1.1×10^{19} fast neutrons per cm^2. The specimens were then electrolytically thinned and examined in an electron microscope. It is concluded that the dislocation loops are not the source of the strengthening in neutron-irradiated Cu or α Cu–Al crystals. (R.E.U.)

18426 THE EFFECT OF THE GAMMA-RAY IRRADIATION ON INTERFACIAL ELECTRICAL PROPERTIES OF POLYPROPYLENE FIBRES. Shizuo Ueda (Kyoto Univ.), Shiro Ishida, Akira Watanabe, and Fukuju Tsuji. Bull. Inst. Chem. Res., Kyoto Univ., 42: 10-21(Jan. 1964).

The zeta potential of polypropylene fibers in contact with surface active agent solutions was measured by streaming potential method, and the free energies of adsorption and numbers of available sites were calculated. It was found that the interfacial electrical behavior of these fibers is strongly influenced by the gamma irradiation in air or water. The infrared absorption spectra were also examined, which showed, in agreement with the results mentioned above, that negatively dissociating groups are formed by the exposure of fibers to the gamma irradiation. (auth)

18427 THERMOLUMINESCENCE OF ROOF TILES IRRADIATED BY ATOMIC BOMBS IN HIROSHIMA AND NAGASAKI. Yoneta Ichikawa (Nara Gakugei Univ., Japan and Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 42: 48-53(Jan. 1964).

The thermoluminescence of roof tiles irradiated by atomic bombs in Hiroshima and Nagasaki was observed for obtaining the distribution of gamma dose, hitherto unknown, from the bombs. The glow-curve from bomb radiation in the past was different due to the decay, in shape at the part of the low temperature, from that of the ^{60}Co radiation at present. But nine samples out of thirty pieces of roof tiles showed that the shape of the glow-curve was similar to that of the artificial one at the part of the higher temperature. In the case of eleven samples, the deformation of the glow-curves was observed at the part of the higher temperature and the rest of the samples did not show any thermoluminescence intensity. In addition, the thermoluminescence intensity of Hiroshima samples is about decuple as large as that of Nagasaki samples for the same dose. (auth)

18428 TRANSIENT CURRENT FROM PLASTIC INSULATORS AND ITS CHANGE BY γ-RAY IRRADIATION. Shigeru Ide and Tatsuo Urai (Japan Defence Agency). Chem. High Polymers (Tokyo), 20: 583-6(Oct. 1963). (In Japanese)

Thin films of polyethylene, polystyrene, polypropylene, polymethylmethacrylate, polycarbonate, polyethyleneterephthalate, and polytetrafluoroethylene were irradiated by 2.8×10^6 r of γ rays in air at room temperature. Before and after irradiation a constant dc voltage was applied to the films. The degree of decay of transient current in each specimen was observed for periods ranging from 20 to 10^3 sec, and each n in the equation $ia = At^{-n}$ was measured. The degrse of decay of transient current in the specimens was radically changed soon after cessation of irradiation, but the effect of irradiation on these specimens was gradually removed. The effect for polystyrene film was removed completely, and the specimen was restored to its initial pre-irradiation state. For the other 6 polymers, an appreciable difference was observed between n for preirradiated specimens and n for irradiated ones even after 360 hrs. The recovery phenomenon was found to be similar to that observed in the recovery of electric conductivity for these polymers. Although it was reported that irradiation of less than 10^7 r had little effect on the electrical properties of plastic insulators, these experiments show that even an irradiation of 10^6 r has an appreciable effect on the decay of transient current. (from NSA of Japan)

18429 MEASUREMENT OF THE WIGNER ENERGY OF BeO. André Roux, Marc Richard, Lucien Eyraud, and Jean Elston. (Centre d'Etudes Nucleaires, Saclay, France). Compt. Rend., 258: 101-2(Jan. 6, 1964). (In French)

The Wigner energy of BeO irradiated at a temperature

below 100°C in a reactor is so low that only a compensation calorimetric method at 1200°C at least is able to furnish usable results. (tr-auth)

18430 IMPROVEMENT OF IRON AND NICKEL STRENGTH BY NEUTRON IRRADIATION. Sh. Sh. Ibragimov and I. M. Voronin. Fiz. Metal, i Metalloved., 15: 895-9(1963). (In Russian)

Effects of neutron irradiation on mechanical properties of Fe and Ni were studied as functions of grain size and radiation dose. It is shown that radiation does not produce identical effects in iron and nickel. Along with improving the yield strength of iron, a partial relaxation was also observed due to Cottrell atmosphere deformations releasing certain dislocations. (tr-auth)

18431 THE EFFECTS OF NON-HYDROSTATIC PRESSURES ON RADIATION-DAMAGE THERMOLUMINESCENCE. Ernest E. Angino (Agricultural and Mechanical Coll. of Texas, College Station). Geochim. Cosmochim. Acta, 28: 381-8(Mar. 1964).

The effects of non-hydrostatic pressures on natural radiation-damage thermoluminescence were studied and ratios between pressure-produced and natural radiation-damage thermoluminescence calculated. The data were obtained by detailed analyses of 550 glow curves obtained by subjecting nine different samples to increasing amounts of pressure for increasing intervals of time and measuring the thermoluminescence produced in each sample as a function of time and pressure. Experimental evidence indicates that effects of pressure are marginal and introduce no serious errors into geologic age determinations based on thermoluminescence. The amount of pressure-produced thermoluminescence obtained at different pressures when plotted against the time of pressure application showed a cyclic variation with increasing time. The cyclic character of the thermoluminescence area-time curves cannot be explained reasonably on basis of present data. Although the fundamental mechanisms at work may involve dislocations, it will be difficult to define these mechanisms more precisely. (auth)

18432 USE OF THE INTERACTION OF THERMAL AND ULTRASONIC WAVES TO STUDY RADIATION-INDUCED DEFECTS IN QUARTZ. Thomas M. Fitzgerald, Bruce B. Chick, and Rohn Truell (Brown Univ., Providence). J. Appl. Phys., 35: 1639-40(May 1964).

Evidence is presented showing that the interaction of high-frequency stress waves with lattice vibration waves provides a means of studying crystal perfection. This discussion is concerned specifically with quartz single crystals, but the method was found to apply to other materials as well. (auth)

18433 CRYSTAL STRUCTURE CHANGES INDUCED BY MULTIPLE IONIZATION ATOMS. A. E. Kiev and S. V. Starodubtzev (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Izv. Akad. Nauk Uz. SSR, Fiz.-Mat. Nauk, No. 5, 37-9(1963). (In Russian)

Recombinations of Frenkel pairs in the high temperature area (developed by delayed auger electrons) were studied in order to determine the mechanism of ionization-induced crystal defects. Ion conductivity of irradiation alkali-halide crystals, analyzed as function of temperature [$\ln \delta(1/T^{\circ})$] at 150°C, revealed a dip in the straight line that develops into a new straight line at room temperature. This peculiarity appeared in the ion structural-sensitive conductivity area. Radioinduced defects in the alkali-halide crystals were easily annealed at 150 to 200°C, while at room temperature they exist for a long time. (R.V.J.)

18434 THE AGING OF ALUMINUM–LITHIUM ALLOYS BEFORE AND AFTER NEUTRON IRRADIATION. C. L. Angerman (E. I. du Pont de Nemours and Co., Aiken, S. C.). J. Nucl. Mater., 11: 41-52(Jan. 1964).

The aging of Al/2.8 wt % Li and Al/1.5 wt % Li alloys was characterized by electron metallography and hardness measurements before and after neutron irradiation. The aging of unirradiated Al–Li alloys followed the same general pattern observed for other aluminum-base alloys. As aging progressed, the hardness increased to a maximum and then decreased. The rate of hardening increased as the aging temperature increased, and the degree of hardening decreased as the lithium content decreased. The precipitate, identified as LiAl, formed as plates that created strains in the aluminum lattice and were responsible for the hardening. The habit plane of the precipitate was the {211} plane and the orientation relationship was (110) Al || (100) LiAl, ($\bar{1}$11) Al || (011) LiAl. During neutron irradiation at relatively low temperatures, some aging occurred that affected the characteristics of postirradiation aging. The aging that occurred during irradiation at 75°C resulted in "retrogression," or temporary softening, during post-irradiation aging at higher temperatures. Irradiation at 125°C produced over-aging. The hardness produced by postirradiation over-aging increased with irradiation exposure. (auth)

18435 COMMENTS ON "ELECTRON MICROSCOPIC OBSERVATION OF DISLOCATION NETWORKS AND RADIATION DAMAGE IN ALPHA URANIUM." R. Krishnan (Atomic Energy Establishment, Bombay). J. Nucl. Mater., 11: 111-13(Jan. 1964).

Critical remarks (and replies to these remarks) are presented on a study of dislocation networks and stacking faults in alpha U. (T.F.H.)

18436 THE STRENGTH OF IRRADIATED BERYLLIUM OXIDE. F. J. P. Clarke (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nucl. Mater., 11: 117-18(Jan. 1964).

The elastic theory of solids is applied to the effects of reactor irradiation on the strength of BeO. (T.F.H.)

18437 ETCHING AND ENLARGING OF FISSION FRAGMENT TRACKS BY ATMOSPHERIC MOISTURE. P. E. Caspar (Cambridge Univ., Eng.). Nature, 201: 1203-4(Mar. 21, 1964).

The preferential etching and enlarging of fission fragment tracks in nickel chlorides and bromined by atmospheric water vapor is reported. (C.E.S.)

18438 AUTORADIOGRAPHY: A USEFUL TOOL FOR EXAMINING IRRADIATED UO_2. R. F. Boyle, W. V. Ketron, R. C. Nelson, and R. E. Smith (General Electric Co., Pleasanton, Calif.). Nucleonics, 22: No. 4, 76-8(Apr. 1964).

The use of autoradiography as a powerful tool for postirradiation examination of UO_2 microstructure is described. Typical results are illustrated and the technique is outlined in detail. (C.E.S.)

18439 IRRADIATION BEHAVIOR OF PLUTONIUM FUELS. V. W. Storhok (Battelle Memorial Inst., Columbus, Ohio). Nucleonics, 22: No. 4, 86(Apr. 1964).

Previous investigations of the irradiation behavior of plutonium alloy and ceramic fuels are briefly reviewed. (C.E.S.)

18440 ELECTRON-SPIN RESONANCES IN GAMMA-RAY-IRRADIATED ALUMINUM OXIDE. F. T. Gamble (Univ. of Connecticut, Storrs), R. H. Bartram, C. G. Young, O. R. Gilliam, and P. W. Levy. Phys. Rev., 134: A589-95 (May 4, 1964). (TID-20152)

Single crystals of α-aluminum oxide were subjected to gamma irradiation at 77°K. A single, asymmetric, paramagnetic-resonance absorption was produced with $g_{||} = 2.012 \pm 0.002$ and $g_{\perp} = 2.008 \pm 0.002$, where || and ⊥ are with respect to the c axis. The line width is about 50 G at 300 and 77°K. The absorption line was analyzed as a superposition of three Gaussian lines with the isotropic g values: $g_1 = 2.020 \pm 0.003$, $g_2 = 2.006 \pm 0.003$, $g_3 = 2.006 \pm 0.003$. The component lines are tentatively attributed to two types of centers: a trapped hole localized on an anion adjacent to a cation site which is deficient in positive charge, and an electron trapped at an anion vacancy. The cation site may be vacant, or may contain a monovalent or divalent substitutional impurity. (auth)

18441 EFFECT OF DISPLACEMENT CASCADES PRODUCED BY IRRADIATION ON RESIDUAL RESISTIVITY OF METALS. A. Corciovei and A. Babcenco (Inst. for Atomic Physics, Bucharest). Phys. Status Solidi, 4: 587-99(1964).

If non-superposed, distant, displacement cascades are produced in a metal, the total resistivity change is equal to the sum of the resistivity changes due to each individual cascade. A study was made of the resistivity change of a single cascade, specifically taking into account the correlation between interstitials and vacancies in the cascades, by means of the distribution functions of the interstitials and vacancies. The ratio between the resistivity change due to the cascade, and the "ideal" resistivity change (corresponding to the production in the metal of an equal number of independent interstitial-vacancy pairs) decreased with an increase in the number of cascade pairs. This result may explain why the resistivity variation obtained experimentally by irradiation is smaller than the resistivity variation obtained theoretically by summing the contributions from individual defects. (auth)

18442 GAMMA IRRADIATION EFFECTS IN RUBY. V. R. Johnson and R. W. Grow (Univ. of Utah, Salt Lake City). Proc. IEEE (Inst. Elec. Electron. Engrs.), 52: 185-6(Feb. 1964).

Studies were made on the effects of gamma radiation on the properties of rubies and sapphires. As single crystal ruby was irradiated, and the usual absorption bands that exist between 200 and 550 mμ changed from four distinct bands to one continuous band inclusive of all wavelengths between 200 and 550 mμ. A slight change was noted from 550 to 650 mμ and then no change for longer wavelengths. Gamma irradiation also showed a great effect on the thermoluminescence given off by ruby. Increased irradiation also caused corresponding increases in the threshold energy of ruby necessary for lasing. Gamma irradiation caused about 50% decrease in transmission in sapphire. (P.C.H.)

18443 X-RAY-INDUCED BULK PHOTOVOLTAIC EFFECT IN INSULATORS. S. I. Taimuty, L. Feinstein, and S. D. Softky (Stanford Research Inst., Menlo Park, Calif.). Science, 144: 173-4(Apr. 10, 1964).

When an insulator, sandwiched between metals of dissimilar work functions, is irradiated with x radiation, a voltage related to the contact potential difference of the metals is observed. This phenomenon, known as the bulk photovoltaic effect, was demonstrated in a variety of metal-insulator-metal combinations. Evidence that the voltage is not generated by junctions, barrier layers, or similar other phenomena is presented. (auth)

18444 IMPURITY PHOTOCONDUCTIVITY IN GERMANIUM IRRADIATED BY HIGH-ENERGY ELECTRONS. R. Yu. Khansevarov (Ioffe Inst. of Physics and Tech., Leningrad). Soviet Phys.-Solid State (English Transl.), 5: 1976-8(Mar. 1964).

It is noted that the similarity of the characteristics of the impurity photoconductivity in germanium irradiated by γ rays and electrons with $E \simeq 2$ Mev shows that the radiation defects have the same energy structure in the two cases. (L.B.S.)

18445 DIFFUSION AND RELAXATION OF THE PROTON SPIN IN IRRADIATED POLYETHYLENES. G. R. Khutsishvili (Inst. of Physics, Academy of Sciences, Tiflis, Georgian SSR). Soviet Phys.-Solid State (English Transl.), 5: 1983-4(Mar. 1964).

Theoretical calculations of the nuclear relaxation time, using the rectangular diffusion barrier model, are shown to be in approximate agreement with experimental data on the proton relaxation time in irradiated high density polyethylenes at helium temperatures. (L.B.S.)

18446 RADIATION DEFECTS IN CADMIUM SULFIDE CRYSTALS. O. R. Niyazova and M. A. Kaneev (Inst. of Nuclear Physics, Tashkent). Soviet Phys.-Solid State (English Transl.), 5: 1997-9(Mar. 1964).

An analysis of surface structural defects produced by gamma radiation was made. It was concluded that the most likely mechanism of the formation of radiation defects is radiative decomposition in the interior of the sample with the products diffusing along the dislocation lines to the surface. (L.B.S.)

18447 GAMMA-RAY INDUCED CONDUCTIVITY IN POLYETHYLENE AND TEFLON UNDER IRRADIATION. Kichinosuke Yahagi (Waseda Univ., Japan). Waseda Daigaku Rikogaku Kenkyusho Hokoku, No. 23, 9-15 (June 1963).

The conductivity induced by ^{60}Co γ rays was measured for low-density polyethylene and teflon films as a function of temperature, dose rate, and applied voltage. In this experiment the dose rate ranged from ~ 10^3 to 10^5 r/hr and the temperature ranged from −80 to +20°C. In both polymers, the induced current at thermal equilibrium was independent of temperature below ~ −40°C, but above −40°C it was fitted by the Arrhenius plot with activation energies from 0.3 to 0.4 ev. It may be concluded that the charge carriers are primarily thermal electrons liberated from traps in the specimens above −40°C, and Compton electrons due to ionization by photons below that temperature. (from NSA of Japan)

METEOROLOGY

18448 (TO-B-63-102(Del.)) RESEARCH ON CIRCULATION IN NUCLEAR CLOUDS. Final Report. H. G. Norment (Technical Operations Research, Burlington, Mass.). Dec. 1, 1963. Contract OCD-OS-62-186. 65p.

A new mathematical model of gas circulation in dynamic nuclear detonation clouds is reported. The model is founded chiefly on classical fluid dynamic theory. Experimental circulation data have been obtained from cine-films of nuclear detonations. A procedure for fitting the circulation model to the observed data has been devised. Exploratory particle motion simulation calculations using the newly developed circulation model have been made. (auth)

18449 TRUDY GLAVNOI GEOFIZICHESKOI OBSERVATORII. VYPUSK 138. VOPROSY TURBULENTNOI DIFFUZII I RASPROSTRANENIYA PRIMESEI V ATMOSFERE. (Reports of the Main Geophysical Observatory. Issue 138. Problems in Turbulent Diffusion and Propagation of Admixtures in Atmosphere). M. E. Berlyand, ed. Tr. Gl. Geofiz. Observ., No. 138, 1-89(1963). Leningrad, Gidrometeorologicheskoe Izd-stvo, 1963. 89p.

Ten articles are presented on distribution of industrial and radioactive aerosols in the atmosphere. Descriptions are given of meteorological conditions conducive to admixture diffusion and turbulent diffusion processes. A separate abstract was prepared for one article of special interest. (R.V.J.)

For abstract of individual papers see: 18239.

PHYSICS

General

18450 (AD-404028) RADIATIVE ENERGY TRANSFER FROM NUCLEAR DETONATIONS ABOVE 50-KM ALTITUDE. R. I. Miller and T. O. Passell (Stanford Research Inst., Menlo Park, Calif.). Apr. 30, 1963. Contract OCD-OS-62-135. 60p.

The thermal energy flux expected at optimally oriented surfaces at the earth's surface from nuclear bursts detonated above 50 kilometers altitude was computed from basic physical principles. The chief principles involved are: (a) absorption by the earth's atmosphere of a blackbody x-ray spectrum from a point source near 10^{7}°K; (b) heating of air to some temperature depending upon its known internal energy-temperature function; (c) radiative cooling of the heated air assuming thermal equilibrium; (d) disposition of the radiant emission into three energy bands; cold oxygen absorption band, ozone absorption band, and the atmospheric passband. (auth)

18451 (AE-136) EJECTION OF URANIUM ATOMS FROM UO_2 BY FISSION FRAGMENTS. Goesta Nilsson (Aktiebolaget Atomenergi, Stockholm). Feb. 1964. 43p.

The numbers of uranium atoms ejected from the surface of sintered plates of UO_2 by fission fragments were measured over the fission density range 5×10^{15} to 7×10^{16} fissions/cm^3. The number of uranium atoms ejected per escaping fragment was about 9. The measurements were performed by irradiating the plates in vacuum and collecting a fraction of the uranium atoms ejected on catcher foils. The amount collected was determined by fission counting. Saturation of the amount collected, as reported by Rogers and Adam, was not observed. The numbers of uranium atoms ejected as knock-ons under the same experimental conditions were calculated. The reasonably close agreement between the experimental and theoretical values indicates that, under the prevailing experimental conditions, mainly knock-ons are ejected. Other ejection mechanisms, e.g. evaporation of material in thermal spikes, are probably insignificant; this is in contrast to the usual interpretation of the ejection process. The mean range in UO_2 of fission products of mass number 140 was found to be 7.37 ± 0.05 mg/cm^2 by direct gamma spectrometric determination of the fraction of ^{140}La escaping from the surface of the plates. The geometry factor of the plate-catcher foil arrangement was determined in a simple way by measuring the distribution of the fission product ^{140}La over the radiation assembly. This method may be applied with advantage also in other sample detector arrangements. (auth)

18452 (AERE-R-4562) A NEW METHOD OF MEASURING FREQUENCY DISTRIBUTIONS OF CRYSTALS. Robert M. Brugger (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1964. 16p.

A measurement of the frequency distribution of the normal modes of vibration of Ni was attempted by a method in which neutrons that are inelastically scattered from a single crystal sample are compared for several scattering angles and several orientations of the crystal. This comparison allows the coherent one-phonon inelastic scattering to be removed and leaves the incoherent one-phonon inelastic scattering which is proportional to the frequency distribution. While no difficulties were encountered that suggest the method will not work, the measurement was only partially successful because of limited resolution. (auth)

18453 (IMM-NYU-320) STRESSES IN A PERFORATED CYLINDRICAL SHELL. Frances Bauer and Edward L. Reiss (New York Univ., New York. Courant Inst. of Mathematical Sciences). Feb. 1964. Contracts NONR-285(42) and AT(30-1)-1480. 32p.

It is assumed that the deformations of a thin cylindrical elastic shell, subjected to a uniform lateral pressure, are adequately described by the Donnell shell equations. The surface of the shell is perforated by a rectangular cutout. The tangential membrane displacements and the normal membrane stresses vanish on the simply supported edges of the hole and the ends of the cylinder. Numerical solutions were obtained by replacing the boundary value problem by a finite difference approximation and solving the resulting system of linear algebraic equations by an iteration procedure. (auth)

18454 (NP-13778) THE MOTION OF A CHARGED PARTICLE IN A CONSTANT HOMOGENEOUS MAGNETIC FIELD AND AN ELECTROMAGNETIC WAVE PROPAGATING PARALLEL TO THE MAGNETIC FIELD. Rijnhuizen Report 64-18. A. Hakkenberg and M. P. H. Weenink (Stichting Voor Fundamenteel Onderzoek der Materie. Instituut Voor Plasma-Fysica, Jutphaas, Netherlands). Jan. 1963. 13p.

The relativistic motion of a charged particle in a constant magnetic field and of an electromagnetic wave propagating parallel to the field was investigated using an expansion in the amplitude of the electromagnetic wave. An expression for the gain or loss of kinetic energy of the particle was obtained. The case of cyclotron resonance particularly, was considered. (auth)

18455 (ORNL-3484) TIME-OF-FLIGHT STUDIES OF ELECTRONS IN VACUUM. D. A. LaBar, J. A. Harter, R. D. Birkhoff (Oak Ridge National Lab., Tenn.). Apr. 1964. Contract W-7405-eng-26. 51p.

An electron gun, drift tube, and fast amplifier (described) were designed and tested as part of a time-of-flight electron beam monochromator. Drift time distributions were obtained for electrons of mean energy from 3 to 15 ev, which required mean transit times from 800 to 350 nsec, respectively, with the latter minimum value corresponding to the effects of amplifier rise time and pulse width from the avalanche transistor pulser. The former value corresponds to an electron energy spread from the electron gun of about 0.6 ev. The reciprocal of the square of the transit time is a linear function of the electron gun accelerating potential with an intercept at −1.5 v attributed to contact potentials. Beam attenuation due to scattering off of residual gas in the vacuum system indicated that pressures below 10^{-6} mm Hg are required in order to avoid loss of electrons in drift distances of the order of one meter. (auth)

18456 (ORNL-TM-306) OR FFE—A FORTRAN CRYSTALLOGRAPHIC FUNCTION AND ERROR PROGRAM. W. R. Busing, K. O. Martin, and H. A. Levy (Oak Ridge National Lab., Tenn.). Mar. 1964. Contract W-7405-eng-26. 86p.

A computer program that calculates interatomic distances, bond angles, principal axes of thermal motion, and other functions of the unit cell parameters, the atomic coordinates, and the temperature factor coefficients of a

crystal structure is described. The standard errors of these functions are computed from the variance-covariance matrix of the parameters if this is known. The program may be used independently, or the input may be taken from a magnetic tape prepared by the crystallographic least-squares program OR FLS. The program is written entirely in Fortran, and detailed instructions for its use are included. (auth)

18457 (ORNL-TM-723) A CODE FOR COMPUTING THE RATE OF FISSION-PRODUCT DEPOSITION FROM A GAS STREAM. J. T. Beard, R. A. Hollister, and T. S. Kress (Oak Ridge National Lab., Tenn.). Mar. 1964. Contract W-7405-eng-26. 18p.

A FORTRAN code was written for the CDC 1604-A computer at ORNL that represents an analytical model for deposition of fission products from gas streams onto conduit surfaces. It will consider systems containing both isothermal and temperature-varying regions with the flow being either laminar or turbulent. Standard heat-mass analogy is used to determine the concentration mass transfer coefficients, and the effect of thermal diffusion is included as an additive term. A sample problem is solved, with the output being both printed and given as a machine plot of deposition versus length along the conduit. (auth)

18458 (SC-DC-64-344) ELECTRICAL AND THERMAL MEASUREMENTS ON FE–AFE PHASE TRANSITIONS IN LEAD HAFNATE TITANATE COMPOSITIONS. Final Report. J. W. Northrip, G. A. Baum, and E. E. Kohnke (Oklahoma State Univ., Stillwater. Research Foundation). Oct. 1963. For Sandia Corp., Albuquerque, N. Mex. Contract AT(29-1)-789. 198p.

Electrical and Thermal Measurements. Investigations have been carried out to determine the characteristics of ferroelectric and antiferroelectric transitions in lead perovskites. Materials studied include solid solutions of lead zirconate titanate, lead zirconate titanate stannate, and lead hafnate titanate. These solid solutions were chosen because compositions among them possess a ferroelectric-to-antiferroelectric transition with rising temperature while others display an antiferroelectric-to-ferroelectric transition under the same conditions. Dielectric constant and loss were determined as functions of temperature and applied electric field, with an emphasis being placed on the use of loss conductance rather than tan δ as a method of examining the loss mechanisms in these materials. By this technique, the variation of transition temperature with external electric field was determined. The decrease of peak dielectric constant with external field characteristic of dielectric saturation was found to be especially prominent in transitions involving a ferroelectric phase. Hysteresis measurements were made primarily in an effort to separate the antiferroelectric double loop behavior from the normal ferroelectric loops near transitions. It was found that parts of some samples retained ferroelectric character many degrees above the normal transition temperature. Measurements of specific heat as a function of temperature were used to determine the relative free energies and entropies of the phases. From the results of these studies it appears that the reversal of transition direction mentioned above results from very slight shifts in the relative magnitudes of the free energy and the entropy of the ferroelectric and antiferroelectric phases of these materials, rather than from some wide change in their structural or chemical character. Dispersion of Dielectric Characteristics. The frequency dependence of the dielectric parameters of some polycrystalline materials exhibiting ferroelectricity and/or antiferroelectricity was examined under varying conditions of temperature and static electric field. Work was performed in the frequency range from 10^2 to 10^5 cps on lead zirconate stannate titanate and lead hafnate titanate solid solutions. The dielectric constant and "equivalent conductance" were determined over a range of temperatures extending from 20°C to 200°C and up to field strengths of 8 kv/cm although the most extensive measurements were made at room temperature and zero field. Both ferroelectric and antiferroelectric phases of the materials were investigated and the trends of the results compared. The samples in general showed a loglinear decrease in dielectric constant with increasing frequency. The antiferroelectric samples displayed a decrease approximately one-third to one-half that of the ferroelectric materials. For all samples, the equivalent conductance values plotted on a log-log scale against frequency yielded a straight line with a slope of very nearly one, suggesting the presence of hysteresis-type losses. These variations with frequency could be altered in various degree by changing temperature or field. Using as a basis the apparent hysteresis-type loss mechanism, a model is proposed which explains the equivalent conductance results and also remains consistent with the dispersion in the dielectric constant. The model involves the concept of minute polarization reversals by domain wall motion. The results at varying temperatures and field strengths are also incorporated into the model. The experimental findings for both the ferroelectric and antiferroelectric compositions show a great deal of consistency with the model, and with this as a foundation, it is suggested that perhaps the solid solution samples are neither purely ferroelectric nor purely antiferroelectric but rather a combination of the two phases with one more dominant. (auth)

18459 (TID-20415) CONDUCTIVITY OF A SHOCK WAVE IN AN ELECTRICAL COAXIAL TUBE (thesis). John Anthony Sivinski (Vanderbilt Univ., Nashville. Graduate School). Sept. 1963. 84p.

The electrical conductivity profile of an electrically produced shock front was measured. Shock flows of up to Mach 40 were obtained using coaxial electrodes. The conductivity of the gas and the shock front velocity were measured with double electrical probes. The curvature of the wave was measured with a smear camera. The conductivity of the front was linear with its Mach number, indicating that it is directly proportional to the energy/ion or the square root of the temperature as calculated by simple shock theory. The risetime of the shock was measured to be about 3 usec. No double structure was observed in the shock. Apparently, electromagnetic fronts do not fit the simple description derived from combustion driven shocks. (D.C.W.)

18460 (UCRL-7613) PREBURST RESISTANCE AND TEMPERATURE OF EXPLODING WIRES. R. C. Maninger (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 24, 1964. Contract W-7405-eng-48. 22p.

The use of the transformation time integrals to calculate the resistance and temperature of a wire as a function of time up to the time of burst is discussed, and the effects of environment of the wire on the temperature, resistance, and time of burst were investigated. (P.C.H.)

18461 (AEC-tr-6341) MECHANISM OF BREAKDOWN IN A VACUUM. C. Germain and F. Rohrbach (European Organization for Nuclear Research, Geneva). Translated for Argonne National Lab., Ill., from "6th International Symposium on Ionization Phenomena in Gases, Orsay, France, July 1963." 16p.

Experiments on d-c breakdown were performed at pressures between 10^{-6} and 10^{-3} torr with large plane

electrodes of different materials spaced from 1 to 10 cm apart. The effects of geometry, surface state, electrode material, and residual pressure were considered. The present theories (examined) do not completely explain the experimental data. A possible development of the microparticle hypothesis, which appears to be the most promising explanation of breakdown, is presented. (D.C.W.)

18462 ON KIRCHHOFF'S SOLUTIONS OF THE ELECTROMAGNETIC DIFFRACTION PROBLEM. Adam Kujawski (Inst. of Physics, Warsaw). Acta Phys. Polon., 25: 7-19(Jan. 1964).

In Kirchhoff's scalar and electromagnetic theory of diffraction, a spliting of Kirchhoff's wave motion into a geometric-optical wave and a boundary diffraction one is possible according to Young's interpretation of diffraction phenomena. The Kirchhoff-Young solutions in the electromagnetic theory in the case of an incident wave radiated by an electric dipole were given by Kottler and subsequently, in a different way, by Laporte and Meixner. It is pointed out that the modified Lorentz theorem and, as its implication, the reciprocity theorems, lead to the electromagnetic Huygens principle expressed in terms of the Lorentz-Larmor formulas, which are usually derived from the unmodified theorem. It is proved that the two Laporte-Meixner solutions conceived as quite differently are equivalent not only to one another but also to Kottler's solutions. The electromagnetic Kirchhoff solutions may be interpreted as the exact solutions of the saltus problem; it is impossible, however, to give such an interpretation to a certain class of the Laporte-Meixner solutions. (auth)

18463 CONSERVATION LAWS FOR THE SPIN-PARTICLE IN THE GRAVITATIONAL FIELD. Andrzej Bialas (Jagellonian Univ., Krakow). Acta Phys. Polon., 25: 71-4(Jan. 1964).

The conservation laws for the spin-particle in the gravitational field admitting a group of motion are derived. (auth)

18464 INTERNAL ABSORPTION PROPERTIES OF ACCELERATING DETECTORS. Richard A. Mould (State Univ. of New York, Stony Brook). Ann. Phys. (N. Y.), 27: 1-12(Mar. 1964).

The existence of electromagnetic radiation from a uniformly accelerated charge has appeared in some recent work to present a problem suggesting the inadequacy of the equivalence principle. For a proper treatment of the problem, it is desirable to show how the absorption properties of detectors are effected by being physically attached to noninertial frames of reference. An invariant criterion of internal absorption is formulated, and is identified with the observable behavior of an elementary detector. It is shown that the properties of a detector fixed in a uniformly accelerated frame are different from the properties of an inertial detector of similar construction, and that this difference is consistent with the usual form of the equivalence principle. (auth)

18465 ROTATIONAL ANALYSIS OF AN ULTRAVIOLET SYSTEM OF THE HYDRIDES AND DEUTERIDES OF Ca, Sr, AND Ba. Gunnar Edvinsson, Ingvar Kopp, Bo Lindgren, and Nils Åslund (Univ. of Stockholm). Arkiv Fysik, 25: 95-105(1964).

Absorption spectra of CaH, CaD, SrH, SrD, BaH, and BaD were studied in the region 2500 to 3500 Å. Systems corresponding to the $^2\Sigma-^2\Sigma$ system, designated F–X, of CaH were observed for the other molecules. Rotational analyses were carried out for the following bands: CaH, 0–0; CaD 0–0, 1–0; SrH 0–0, 1–0; SrD 0–0, 1–0; BaH 0–0; BaD 0–0, 1–0. The constants derived for the upper levels are tabulated. A digital computer was used to calculate wave numbers and constants. (auth)

18466 A SIMPLE DERIVATION OF SCHWARZSCHILD'S METRIC. K. E. Eriksson (Uppsala Univ.). Arkiv Fysik, 25: 167-73(1964).

With the use of local Lorentz transformations, Schwarzschild's exterior solution of Einstein's equations is derived from the principle of equivalence, the special theory of relativity (applied locally), and Newton's law is taken to mean that the acceleration field is proportional to the mass of the gravitating center and divergence-free outside this center when described in a local frame that is freely falling radially towards the center from rest at infinity. (auth)

18467 EVIDENCE OF A TEMPERATURE EFFECT ON THE MEAN IONIZATION ENERGY IN GASEOUS MIXTURES CONTAINING METASTABLE ATOMS. Pierre Bristeau. Compt. Rend., 258: 1760-3(Feb. 10, 1964). (In French)

Experiments on ionization in gases by α particles are described. It was observed that the mean ionization energy W does not vary with the temperature T in the pure gases He, Ne, Ar, Kr, Xe, Air, N_2, O_2, CO_2, CH_4, and SF_6. In Ne or He containing small quantities of a gas ionizable by metastable atoms, W is lower at 77°K than at 300°K. The difference $\Delta W = W_{300} - W_{77}$ was studied as a function of the concentration of the impurity. (tr-auth)

18468 EFFECTS OF SEPARATE ELEMENTARY PROCESSES ON THE CHARACTERISTICS OF HIGH-VOLTAGE DISCHARGE. L. G. Guseva. Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 141-6(Jan. 1964). (In Russian)

The magnitudes of certain processes in high-voltage discharge were estimated by determining the reduction coefficient (W) induced by the processes. W is the number of electrons produced in a cathode as a result of ionization processes initiated by a primary emitted electron. The difference between W and unity describes the magnitude of a given process. (R.V.J.)

18469 DIELECTRIC BREAKDOWN OF SINGLE-CRYSTAL STRONTIUM TITANATE. Harrison H. Barrett (Raytheon Co., Waltham, Mass.). J. Appl. Phys., 35: 1420-5(May 1964).

Measurements of the intrinsic dielectric breakdown strength of single-crystal strontium titanate over a temperature range from −195 to +100°C, and under both pulse and d-c conditions are described; d-c breakdown at +100°C is thermal in origin. At room temperature and at −40°C the breakdown strength is independent of duration of applied field and of sample configuration and hence may properly be termed intrinsic. At −80 and −195°C, both the values of breakdown strength and the scatter of the data depend strongly on sample configuration. The breakdown strength unexpectedly decreases with increasing temperature. Current-voltage curves show an anomalous saturation effect at low temperature. These effects may be qualitatively explained by postulating that the high electrostrictive stress causes the creation of electron trapping centers. (auth)

18470 EXO-EMISSION FROM ABRADED AND ETCHED ALUMINUM. R. K. Mueller and Ken Pontinen (General Mills, Inc., Minneapolis). J. Appl. Phys., 35: 1500-2(May 1964).

Successive surface layers were removed from freshly abraded and from abraded and aged Al by chemical etching and the exo-emission of the new surface observed in a Geiger-Mueller counter. Aging affected emission properties only in extremely thin surface layers. A one-second etch in 1% HF was sufficient to recover 90% of original activity.

Decay rates of original and recovered activity and distribution of potentially active centers in depth was not affected significantly by aging. (auth)

18471 SOME OBSERVATIONS ON CONDUCTION THROUGH THIN TANTALUM OXIDE FILMS. C. L. Standley and L. I. Maissel (International Business Machines Corp., Poughkeepsie, N. Y.). J. Appl. Phys., 35: 1530-4(May 1964).

The electrical properties of several tantalum oxide diodes with various metal counterelectrodes were studied. The devices were prepared on sputtered tantalum by anodizing to the desired oxide thickness (100 to 200 Å) and evaporating the second metal electrode in vacuum. The devices show a work function dependence on the second metal electrode that also appears to be affected by the manner in which the original tantalum was prepared. The temperature behavior of this and several other oxide diode systems follow a Schottky relation fairly well, with deviations at low temperatures and thinner oxide layers, as expected. (auth)

18472 PROPERTIES OF RARE-EARTH NITRIDES. N. Sclar (Fairchild Camera and Instrument Corp., Clifton, N. J.). J. Appl. Phys., 35: 1534-8(May 1964).

The optical and electrical properties of the rare-earth nitrides DyN, ErN, and HoN as well as ScN and YN were surveyed. From absorption edges found in the optical transmission curves, energy gaps in the 2-ev range were determined as follows: DyN 2.60 to 2.90 ev, ErN 2.40 to 2.78 ev, HoN 1.70 to 1.88 ev, where the spread in energies is due to differences observed in two experimental runs. For ScN and YN no definite absorption edge was found. The electrical properties from 80 to 1500°K were found to be metallic with associated large concentrations of electron carriers. These results are interpreted to suggest that the present species of nitrides which were all deficient in nitrogen content are high energy gap defect type degenerate semiconductors. The large concentrations of charge carriers are attributed to the lack of stoichiometry so far achieved. (auth)

18473 AN EXPERIMENTAL BOMBARDMENT ION SOURCE. P. C. McNeill (Elliott Brothers (London) Ltd.). J. Brit. Interplanet. Soc., 19: 278-85(Jan.-Feb. 1964).

A 2.5-cm-diam. bombardment ion source is described. Details of the performance are given and related to other published data. The maximum overall efficiency of the source was about 40% at a beam current density of about 2.8 mamp cm^{-2}. The overall energy per ion was in the region of 10,000 ev. Although this value is large, it relates quite well to the behavior of scaled sources. (auth)

18474 SPIN LATTICE RELAXATION OF ^{19}F IN CRYSTALLINE XENON TETRAFLUORIDE. Charles G. Wade and J. S. Waugh (Massachusetts Inst. of Tech., Cambridge). J. Chem. Phys., 40: 2063-4(Apr. 1, 1964).

The results of measurements of the spin-lattice relaxation time T_1 of the ^{19}F nuclei in crystalline XeF_4 at 30 Mc/sec over the temperature range 77 to 373°K are presented. The plot is linear between 250°K and the melting point, indicating that the relaxation is dominated by a single type of thermally activated molecular motion. At low temperatures, however, the plot departs from linearity, and T_1 approaches a value of approximately 1000 sec at 77°K. The slope yields a value for the activation energy, E_a, of 12.0 ± 1.5 kcal/mole. (P.C.H.)

18475 ON THE THEORY OF DE BROGLIE WAVES IN SPACE-TIME. J. Kulhánek. Nuovo Cimento (10), 31: 978-85(Mar. 1, 1964).

The connection between generally covariant Hamiltonian formalism and wave processes in space-time is considered. It is indicated that the Hamilton-Jacobi equation is representing the characteristic condition for a nonlinear second-order differential equation of the hyperbolic type that describes a wave process in space-time. The wave 4-velocity of wave process is the same as the particle 4-velocity (ray velocity) and is equal to one. The equality of wave velocity and the ray velocity enable us to put the point and wave model of particle into mutual correlation. (auth)

18476 ON THE KINETIC THEORY OF A WEAKLY COUPLED GAS. G. Sandri (Aeronautical Research Associates of Princeton, Inc., Princeton, N. J.). Nuovo Cimento (10), 31: 1131-2(Mar. 1, 1964).

Convergence difficulties from synchronization assumptions are considered for a spatially homogeneous weakly coupled (classical) gas using the two-particle correlation function. (R.E.U.)

18477 NOTE ON THE MÖSSBAUER EFFECT OBSERVED IN UO_2 SINGLE CRYSTALS. M. De Coster, L. Mewissen, and M. Verschueren (S.C.K., Mol, Belg.). Phys. Letters, 8: 293-4(Mar. 1, 1964).

Impurity iron behavior in cobalt-57-doped UO_2 single crystals was studied by the Mössbauer effect. (R.E.U.)

18478 THE RAYLEIGH-TAYLOR INSTABILITY OF A COMPRESSIBLE CONDUCTING FLUID IN THE PRESENCE OF A MAGNETIC FIELD. Y. K. Verma and Pratibha Verma (Univ. of Delhi). Proc. Natl. Inst. Sci. India, Pt. A, 29: 309-15(May 26, 1962).

The Rayleigh-Taylor instability for an interface separating two compressible media was investigated in the presence of a horizontal magnetic field. In incompressible fluids for the disturbances perpendicular to the direction of H, the magnetic field does not affect the development of Rayleigh-Taylor instability, but in case of compressible fluids the magnetic field affects the development of Rayleigh-Taylor instability for such disturbances also. The critical wave number below which Rayleigh modes do not exist is found. Thus the magnetic field has a stabilizing effect on Rayleigh-Taylor disturbances. (auth)

18479 THE RAYLEIGH-TAYLOR INSTABILITY OF A ROTATING COMPRESSIBLE INVISCID FLUID. Y. K. Verma and Pratibha Verma (Univ. of Delhi). Proc. Natl. Inst. Sci. India, Pt. A, 29: 316-18(May 26, 1962).

Rayleigh-Taylor instability of a rotating compressible inviscid fluid was investigated. The coriolis force for unstable configuration decreases the critical wavelength of perturbations that give rise to Rayleigh modes, while for stable configurations it increases this critical wavelength. (auth)

18480 THE RAYLEIGH-TAYLOR INSTABILITY OF A ROTATING COMPRESSIBLE CONDUCTING FLUID IN THE PRESENCE OF A MAGNETIC FIELD. Y. K. Verma and Pratibha Verma (Univ. of Delhi). Proc. Natl. Inst. Sci. India, Pt. A, 29: 319-24(May 26, 1962).

The Rayleigh-Taylor instability of a rotating compressible conducting fluid in the presence of a magnetic field was investigated. It is found that for a stable configuration the magnetic field and rotation both enhance the critical wavelength of the perturbation that gives rise to Rayleigh modes, while for an unstable configuration a magnetic field enhances the critical wavelength whereas rotation decreases this critical wavelength. (auth)

18481 ON THE KUTTA-JOUKOWSKI CONDITION IN MAGNETOFLUID DYNAMICS. K. Stewartson (Durham Univ., Eng.). Proc. Roy. Soc. (London), Ser. A, 277: 107-24(Jan. 7, 1964).

The effect of an aligned magnetic field H_∞ on the lifting force, experienced by a flat plate at incidence in a conducting field, is examined with respect to variations in the conductivity σ and in H_∞. The governing integral equation does not possess a unique solution unless the velocity (and pressure) are required to be finite either at the trailing edge or at the leading edge of the plate. It is then solved numerically for various finite values of σ and its asymptotic behaviour is examined analytically. The conclusions are: If the undisturbed fluid velocity $V > H_\infty/(4\ \mu\rho)^{1/2}$, the Alfvén speed, the solution as $\sigma \to \infty$ formally satisfies the same side condition as was imposed at finite σ. If $V < H_\infty/(4\ \pi\rho)^{1/2}$ and the velocity is required to be finite at the trailing edge, as $\sigma \to \infty$, the velocity formally becomes finite at the leading edge and develops a quasisingular behaviour at the trailing edge. On the other hand, if $V < H_\infty/(4\ \pi\rho)^{1/2}$ and the velocity is required to be finite at the leading edge, the solution appears to become pathological as $\sigma \to \infty$. In the critical case $V = H_\infty/(4\ \pi\rho)^{1/2}$, the solution is unique for all $\sigma < \infty$, and in the limit solution the velocity must be finite at the trailing edge. The theory here is also relevant to the Oseén flow past an inclined flat plate. Finally, it is shown that if the velocity is required to be finite at the leading edge, then the solution of the integral equation becomes singular to at least one value of σ for all H_∞ such that $H_\infty^2 > 0.906\ (4\ \pi\rho V^2)$. (auth)

18482 EFFICIENCY OF CYLINDRICAL COIL SYSTEMS IN MAGNETIC SUSCEPTIBILITY MEASUREMENTS. C. Scheringer (Iowa State Univ., Ames). Rev. Sci. Instr., 35: 515-16(Apr. 1964).

One method of measuring magnetic susceptibilities is the mutual inductance technique in which a sample is placed in the center of two coils, the mutual inductance of which is measured with a bridge system. A formula describing the efficiency of a cylindrical coil system is derived for samples symmetric with respect to rotation about the cylinder axis z and to reflection about z = 0. The formula is $\eta = l_p l_s/4(l_p^2/4 + \rho_0^2)^{1/2}\ (l_s^2/4 + \rho_0^2)^{1/2}$, where l_p and l_s = length of primary and secondary coils and ρ_0 = radius of coils. (D.L.C.)

18483 APPLICATION OF ELECTRONIC COMPUTERS TO EXPERIMENTAL NUCLEAR PHYSICS. Leon J. Lidofsky (Columbia Univ., New York). Trans. N. Y. Acad. Sci., 26: 27-39(Nov. 1963).

Data acquisition and reduction using computer techniques are discussed. High-energy experiments with computer components and systems that adjust themselves according to incoming information in such a way as to optimize the acquisition of desired information are discussed. (R.E.U.)

18484 STUDIES ON X-AGENT. XVII. APPARENT TRANSMITTANCE CHANGE IN TRANSPARENT SURFACE OF A GLASS VESSEL DUE TO X AGENT. Hideo Moriyama (Shonan Hygiene Inst., Kamakura, Japan). Yokohoma Med. Bull., 13: 149-71(Apr. 1961).

Further characteristics of the hypothetical X-agent, possibly of cosmic origin, were investigated. The phenomenon, previously reported concerning the transmittance change of a frosted glass surface, was observed also in the transmittance change of the transparent glass surface under the effect of X-agent. The phenomenon is generally less marked in the transparent surface than in the frosted surface, but the nature of the phenomenon is said to be essentially the same. Water, also, itself behaves like the transparent glass in its response to X-agent. Lead blocks, surrounding the glass and water, altered the effect of X-agent. It is suggested that the photon on passing through the transparent glass or through the water becomes capable of affecting the sensitivity of a photoelectric cell in a photometer. It is furthermore proposed that the materials are altered to an unstable state, or an excited state, under the influence of X-agent, and that photons passing through the material are temporarily changed in character to act as X-agent, which is capable of introducing an unstable state in other materials. The sensitivity of the photoelectric cell is said to be altered because of such induction of an unstable state. (BBB)

18485 EFFECTS OF LOCAL STRUCTURE ON THE ANGULAR CORRELATION OF ANNIHILATION EMISSION IN YTTRIUM. V. L. Sedov (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 45: 2070-1(Dec. 1963). (In Russian)

The angular correlation of γ quantum pairs in positron annihilation in solids was used to describe the distribution function of valence electrons in phase space. Measurements were made of certain details in the angular distribution of annihilation quanta using polycrystalline yttrium at room temperature. (R.V.J.)

18486 RESONANCE INTERACTION OF RADIATION WITH THE MEDIUM. A. P. Kazantsev and V. S. Smirnov (Inst. of Radiotechnology and Electronics, Academy of Sciences, Siberian SSR). Zh. Eksperim. i Teor. Fiz., 46: 182-6(Jan. 1964). (In Russian)

The case in which resonance interaction between radiation and the medium is determined by collective processes is considered. It is shown that for low radiation energies the interaction results in modulation of the electromagnetic field. The de-excitation time of the nonequilibrium medium due to collective processes is also determined. (auth)

18487 PROCEEDINGS OF THE INTERNATIONAL SCHOOL OF PHYSICS "ENRICO FERMI." COURSE XXII. SEMICONDUCTORS. VARENNA ON LAKE COMO. VILLA MONASTERO. JULY 17 – AUGUST 5, 1961. R. A. Smith, ed. New York, Academic Press, 1963. 547p. $22.00.

Separate abstracts were prepared for 4 of the 16 lectures presented. Not included were band structure of semiconductors, interactions of imperfections in homogeneous and heterogeneous phase equilibria, transport of excess carriers in semiconductors, semiconductor chemistry, transition-metal oxides, organic semiconductors, the effective-mass approximation, lattice vibration spectra of semiconductors, piezoresistance in p- and n-type germanium, and optical properties of semiconductors. (R.E.U.)

For abstracts of individual lectures see: 18488, 18489, 18490, and 18491.

18488 LATTICE DYNAMICS. W. Cochran (Cambridge Univ., Eng.). p.50-67 of "Semiconductors." New York, Academic Press, 1963.

A Newtonian approach is taken in an introduction to lattice dynamics within the adiabatic and harmonic approximations. Ionic crystals are emphasized. (R.E.U.)

18489 CYCLOTRON RESONANCE AND MAGNETO-OPTICAL EFFECTS IN SEMICONDUCTORS. B. Lax (Massachusetts Inst. of Tech., Lexington and Massachusetts Inst. of Tech., Cambridge). p.240-340 of "Semiconductors." New York, Academic Press, 1963.

Microwave, millimeter, and infrared cyclotron resonance are discussed classically and quantum mechanically. Intraband, interband, and Zeeman magneto-optical phenomena are discussed. 110 references. (R.E.U.)

18490 THERMO-ELECTRIC AND THERMO-MAGNETIC EFFECTS. L. Sosnowski (Univ. of Warsaw). p.436-57 of "Semiconductors." New York, Academic Press, 1963.

Band structure and electron-phonon interactions are dis-

cussed from thermoelectric and thermomagnetic effects in semiconductors. The Boltzmann-Lorentz equation for stationary state is used to connect measured values of thermoelectric and thermomagnetic coefficients with such parameters as mobility, effective mass, and mean-free-path of electrons and phonons. Scattering on thermal vibrations by acoustic phonons, by optical phonons, and on ionized impurities are considered. Parabolic bands, the many-band case, and nonparabolic bands are discussed. 18 references. (R.E.U.)

18491 MAGNETIC SUSCEPTIBILITY OF SEMICONDUCTORS. C. P. Enz (Universite, Neuchatel, Switzerland). p.458-78 of "Semiconductors." New York, Academic Press, 1963.

The magnetic susceptibility per unit volume of semiconductors in weak static fields is discussed. Magnetism of free and tightly bound electrons is discussed. Magnetism of Bloch electrons and its applications are discussed. 52 references. (R.E.U.)

18492 MAGNETIC AND ELECTRIC RESONANCE AND RELAXATION. Proceedings of the XIth Colloque Ampere, Eindhoven, July 2-7, 1962. J. Smidt, ed. Amsterdam, North-Holland Publishing Company, 1963. 597p. $22.50.

Magnetic relaxation of electrons and of nuclei, relaxation of atoms and molecules, magnetic resonance of electrons and of nuclei, double resonance, and measuring apparatus are discussed in the 121 papers presented. (R.E.U.)

18493 ASTRONAUTICAL ENGINEERING AND SCIENCE FROM PEENEMÜNDE TO PLANETARY SPACE, HONORING THE FIFTIETH BIRTHDAY OF WERNHER VON BRAUN. Ernst Stuhlinger, Frederick I. Ordway, III, Jerry C. McCall, and George C. Bucher, eds. New York, McGraw Hill Book Company, Inc., 1963, 413p. $17.50.

Systems and operation, advanced propulsion, guidance, control and tracking, spacecraft, and space physics and exploration are discussed in the 18 chapters written by friends and associates of Wernher von Braun. Separate abstracts were prepared for 4 chapters. (R.E.U.)

For abstracts of individual chapters see: 18494, 18495, 18610, and 19265.

18494 ELECTRIC PROPULSION: A NEW TECHNOLOGY. Ernst Stuhlinger, Robert N. Seitz, George C. Bucher, and Gerhard B. Heller (George C. Marshall Space Flight Center, Huntsville, Ala.). p.103-28 of "Astronautical Engineering and Science." New York, McGraw-Hill Book Co., Inc., 1963.

The present and future roles of electric thrust devices are discussed. Ion and arc engines and plasma accelerators are discussed. 34 references. (R.E.U.)

18495 A PROPOSED ELECTRIC SPACESHIP ENGINE. Hermann J. Oberth. p.129-45 of "Astronautical Engineering and Science." New York, McGraw-Hill Book Co., Inc., 1963.

An electric engine is described that creates an electric wind consisting of colloidal particles. Losses by dispersion, ionization, scattering, and inequalities in particle mass are considered. The efficiency of such a propulsion system and useful missions for colloidally propelled space vehicles are discussed. (R.E.U.)

18496 AN ABSOLUTE LIGHT INTENSITY CALIBRATION IN THE FAR ULTRAVIOLET. J. van Eck and F. J. de Heer (F.O.M. Laboratorium voor Massascheiding, Amsterdam). p.11-13 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

The method is based on the observation of two helium spectral lines from a common upper level 3^1P, which lie in the visible and far ultraviolet spectral region. The intensity of the visible line is measured with an absolutely calibrated monochromator (2000 to 6000 Å). By knowledge of theoretical transition probabilities the intensity of the ultraviolet radiation can be calculated. The spectral lines arise when fast helium ions (30 kev) are shot into some target gas with capture of an electron into the 3^1P state, so that the emitted He I radiation is not absorbed. (auth)

18497 EXPERIMENTAL VERIFICATION OF THE EQUATION OF STATE OF HYDROGEN BY MEANS OF A SHOCK TUBE. A. Brin, F. Delobeau, P. Veyrie, and J. P. Plantevin (CEA, Paris). p.377-87 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In French)

Optical measurements were performed on an electromagnetic shock tube. The velocity of the shock wave before and after its reflection on a metallic surface is discussed, and the measurement of electron density behind the shock front is described. The experimental profile of the H_β line is compared with theoretical results. Agreement is found with a tentative verification of the equation of state for a shock-heated hydrogen plasma associated with Hugoniot equations. (R.E.U.)

18498 EFFECT OF A CsF ATMOSPHERE ON ELECTRON EMISSION FROM TUNGSTEN. A. Jester and A. Minor (Brown, Boveri, and Cie AG, Mannheim, Ger.). p.527-31 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In German)

Recent measurements of the so-called Langmuir "S curves" with the system Mo–CsF–Cs exhibit greater emission currents than those of the system Mo–Cs at equal cesium pressures. For that reason the application of CsF in a thermionic converter should be important. At higher emitter temperatures however (above 1800°K), there is no difference between these two systems because the partial pressure of cesium fluoride, which is in thermal equilibrium with the cesium bath, is too low to establish a stable layer of fluorine on the emitter surface. Experiments are investigated on the electron emission of a tungsten filament as a function of cesium fluoride bath temperature. The methods used to measure electron currents and cesium fluoride pressure are described. Measurements of emission currents for a number of tungsten filament temperatures at various cesium fluoride pressures are presented. (auth)

18499 EFFECTS OF MOLECULAR FLOW IN PLASMA GENERATION AND SOME ANALYSES OF SPACE CHARGE FLOW IN ION ACCELERATION. Edward A. Richley and William R. Mickelsen (National Aeronautics and Space Administration, Cleveland). New York, American Inst. of Aeronautics and Astronautics, 1964, Preprint 64-7, 12p, $1.00. (CONF-392-1)

From Aerospace Sciences Meeting, New York, Jan. 1964.

The role of molecular flow in electron-bombardment ion chambers is discussed, and some inferences are derived from postulated flow models. These inferences are compared with experimental results obtained from ion chambers. A digital computer program for solving two-dimensional and axisymmetric space-charge flow problems is presented. Solutions are given for some contact-ionization thrustor configurations operating under space-charge-limited and less than space-charge-limited modes. (auth)

18500 SPACE CHARGE ACCELERATION OF IONS AT ELECTRON CYCLOTRON RESONANCE. S. A. Ahmed and H. W. Hendel (Radio Corp. of America, Princeton, N. J.).

New York, American Inst. of Aeronautics and Astronautics, 1964, Preprint 64-24, 8p, $1.00. (CONF-392-9)

From Aerospace Sciences Meeting, New York, Jan. 1964.

Results are presented for a continuously operating plasma accelerator. Power from a 2.45-kMc electromagnetic field is transferred at electron cyclotron resonance to a mercury plasma in a wave-guide resonator located in a steady axial magnetic field of 870 gauss. Due to the tensor nature of the plasma transport properties in the magnetic field, the r-f energy initially absorbed by the electrons is converted to axial kinetic energy of the ions, and a well collimated plasma beam emerges axially. Langmuir probe measurements reveal that a space potential gradient is set up between the higher pressure r-f plasma interaction region and the lower pressure region outside. This measured potential difference accounts for the acceleration of the ions to energies of 35 to 150 ev in the beam and their narrow energy spread, as measured by a retarding field ion energy analyzer. The final ion energy and the potential difference show a linear relation to the plasma electron temperature. Approximately 30% of the absorbed microwave power is converted to directed ion kinetic energy. The configuration of the constant magnetic field has a marked effect on the efficiency. With a second microwave probing signal of slightly different frequency, measurements were made on the microwave penetration into the magnetized plasma. Consistent with theory, penetration was found to depend on the conditions for whistler-mode propagation being satisfied. (auth)

18501 FACTORS INFLUENCING ELECTRICALLY SPRAYED LIQUIDS. J. J. Hogan, R. S. Carson, J. M. Schneider, and C. D. Hendricks (Univ. of Illinois, Champaign). New York, American Inst. of Aeronautics and Astronautics, 1964, Preprint 64-12, 6p, $1.00. (CONF-392-7)

From Aerospace Sciences Meeting, New York, Jan. 1964.

The instability of preformed charged liquid droplets, when injected into an accelerating field, is discussed. An instability condition, which relates the electric field to the droplet radius, was derived by equating the maximum electric stress on the droplet to the pressure due to surface tension. The theoretical results are found to compare favorably with experimental data. Specific-charge measurements for various pure liquids, doped liquids, and solids suspended in glycerine are presented. The influence of temperature, accelerating voltage, and liquid pressure is discussed. Data are presented showing specific charges above 200 coul./kg. The specific charge of emitted particles was found to be dependent on the period and width of the natural pulsations of the emitting surface. (auth)

Accelerators

18502 (AERE-A/R-2538) 7 Gev PROTON SYNCHROTRON MAGNET: APPARATUS FOR MEASURING FIELD AND FIELD GRADIENT IN MAGNET MODELS. D. A. Gray and A. H. Spurway (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Aug. 1958. 24p.

The electronic integrator and servo-fluxmeter used for the investigation of pulsed and steady magnetic fields in small-scale models of the 7-Bev proton synchrotron magnet are described. The electronic integrator has a linearity of 1 part in 1500 and a short term drift of $<2 \times 10^{-3}$/RCmv/sec., where RC is the integrator time constant. The servo fluxmeter has a range of about 3×10^6 line turns, a discrimination of about 500 line turns, and a short term drift of $<10^3$ line turns/min. (auth)

18503 (CERN-64-15) SCOPT — AN IBM 7090 CODE FOR BEAM OPTICS PROBLEMS ON THE SYNCHRO-CYCLOTRON. P. Skarek (European Organization for Nuclear Research, Geneva). Mar. 18, 1964. 22p.

The program SCOPT calculates charged-particle trajectories in a synchrocyclotron field and determines all the beam properties needed for further matching and tracking through the layout by the TRAMP program. Input, output, subroutines, and use are described; and the results of some calculations for a 70-Mev meson(π^+) beam are included. The program is in FORTRAN II for a 32-k IBM 7090 under monitor control. (D.C.W.)

18504 (JINR-P-1502) DEPOLYARIZATSIYA PROTONOV V IZOKHRONNYKH TSIKLOTRONAKH. (Proton Depolarization in Isochronous Cyclotrons). Yu. A. Plis and L. M. Soroko (Joint Inst. for Nuclear Research Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 11p.

Using the design topography of the magnetic field in a 700-Mev relativistic cyclotron, the median plane distortions of the magnetic field at which it is possible to accelerate polarized protons without an essential depolarization were calculated. (auth)

18505 (NP-13713) UMEN'SHENIE CHASTOTY SLEDOVANIYA SGUSTKOV IONOV V TSIKLOTRONE IAE. (Decreasing the Repetition Rate of Ion Clusters in the Cyclotron of the IAE (Institute of Atomic Energy)). A. V. Antonov, M. V. Blokhov, N. I. Venikov, S P. Kalinin, A. A. Kurashov, P. E. Perov, and A. A. Chesalov (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoĭ Energii and Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoĭ Energii). 1963. 8p.

A device was developed for decreasing, by a factor of 4, the repetition rate of ion clusters at a cyclotron target. Ion deflections were accomplished by a high frequency sinusoidal potential applied to a special deflecting system distributed in an ion conductor. Formulas were derived for calculating the shape of electrodes for the deflecting system and the required high-frequency potential. A block diagram of the system is given. (tr-auth)

18506 (NP-13787) SIXTH ANNUAL REPORT FOR THE PERIOD OCTOBER 1, 1962 TO SEPTEMBER 30, 1963 [ON NUCLEAR SCIENCE]. (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Harwell, Berks, England and Gt. Brit. National Inst. for Research in Nuclear Science. Daresbury Nuclear Physics Lab., Ches, England). 40p.

The sixth annual report of the Rutherford High Energy Laboratory contains information on high-energy physics, nuclear physics, development and operation of Nimrod proton synchrotron, radiochemistry, development of accelerators and electrostatic generators, operation and research programs of 50-Mev proton linear accelerator, development of Nina electron synchrotron, development of Atlas computer laboratory, research reactor programs, bubble chamber development, finances, membership, administrative matters, and research programs. (N.W.R.)

18507 (ORNL-3505) MEASUREMENT OF THE INTENSITY OF THE PROTON BEAM OF THE HARVARD UNIVERSITY SYNCHROCYCLOTRON FOR ENERGY-SPECTRAL MEASUREMENTS OF NUCLEAR SECONDARIES. R. T. Santoro and R. W. Peelle (Oak Ridge

National Lab., Tenn.). Mar. 1964. Contract W-7405-eng-26. 59p.

Two thin helium-filled parallel-plate ionization chambers were designed for use in continuously monitoring the 160-Mev proton beam of the Harvard University Synchrocyclotron over an intensity range from 10^5 to 10^{10} protons/sec. The ionization chambers were calibrated by two independent methods. In four calibrations the charge collected in the ionization chambers was compared with that deposited in a Faraday cup which followed the ionization chambers in the proton beam. In a second method, a calibration was made by individually counting beam protons with a pair of thin scintillation detectors. The ionization chamber response was found to be flat within 2% for a five-decade range of beam intensity. Comparison of the Faraday-cup calibrations with that from proton counting shows agreement to within 5%, which is considered satisfactory. The experimental results were also in agreement, within estimated errors, with the ionization chamber response calculated using an accepted value of the average energy loss per ion pair for helium. A slow shift in the calibrations with time is ascribed to a gradual contamination of the helium of the chambers by air leakage. (auth)

18508 (UCRL-10652) BEVATRON OPERATION AND DEVELOPMENT. NO. 36, OCTOBER–DECEMBER 1962. Kenneth C. Crebbin and Rudin M. Johnson (California. Univ., Berkeley. Lawrence Radiation Lab.). Dec. 16, 1963. Contract W-7405-eng-48. 25p.

The shielding foundation was completed and some of the wall and roof blocks were placed in position. The travel-target track was extended to cover all of the normally used target area. A vacuum-to-air lock was installed in the west straight section to permit installation and removal of targets. The internal deflection magnets for the external beam were installed in the Bevatron along with their hydraulic plunging systems. A new three-sector stanchion and secondary-beam exit port were installed at the exit of quadrant II. A new thin window was installed in the outside west face plate for external and secondary beam. The magnet sectors were repositioned to put the Bevatron magnet on a tilted plane. Graphite and aluminum beam stoppers were placed in the Bevatron gap to protect equipment and parts from the higher energy and intensity injected beam. The new linac injector system was moved into position and all the components adjusted and tested. The first beam (19.2 Mev) injected into the Bevatron tank gave 9 to 10 ma current at the exit of the inflector. (auth)

18509 (UCRL-10863) BEVATRON OPERATION AND DEVELOPMENT. NO. 37, JANUARY–MARCH 1963. Kenneth C. Crebbin, Rudin M. Johnson, and William L. Everette (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 13, 1964. Contract W-7405-eng-48. 22p.

January was devoted to restoring the mechanical and electrical equipment of the Bevatron to operating condition after the seven-month shutdown. February and the first two weeks of March were devoted to testing and learning the new operating characteristics of the Bevatron and new injection system. Operation for experimental research started on March 15. By the end of March three primary experimental groups were operating on a beam-sharing basis. The new radiation shielding for the Bevatron was in place, and a system for controlled entry of people into the unshielded area was established. Background radiation measurements were made in the building area outside the shielding wall. During the March 7 vacuum shutdown, a radiation survey was made inside the Bevatron vacuum chamber to check for induced activities from the new 19.2-Mev injector system. (auth)

18510 INCREASE OF THE PROTON BEAM LEVEL IN THE 6-METER PHASOTRON OF THE JOINT INSTITUTE FOR NUCLEAR STUDIES. V. I. Danilov, I. B. Enchevich, B. I. Zamolodchikov, B. N. Marchenko, D. L. Novikov, E. A. Polferov, E. I. Rozanov, A. L. Savenkov, and A. N. Safonov. At. Energ. (USSR), 16: 9-11(Jan. 1964). (In Russian)

The capture of particles and their phase shift to a finite radius during the acceleration process must be taken into consideration when analyzing the characteristics of the phasotron; the frequency and the amplitude of the accelerating voltage needed to accelerate the particles to their ultimate radius must be at their maximum. These characteristics of the phasotron of the Joint Institute for Nuclear Studies were determined during 1961/62. The proton energies were measured as functions of the orbital radius and of the potential field of the duant of the ion source and of the accelerating chamber of the phasotron. On the basis of the results obtained, it was found possible to provide simultaneously optimal conditions for both the capture and the acceleration of the proton beam to its ultimate radius without phase loss. The data indicated that the value of the accelerated proton flux at the ultimate radius was increased from 0.3 to 1.1 to 1.2 μamp. (TTT)

18511 DEUTERIUM THYRATRONS FOR HARWELL ACCELERATOR. L. E. Algar (General Electric Co., Hirst Research Center, Wembley, Eng.), J. E. Marshall, and C. R. Russell. Atomics, 17: 30-4(Mar.-Apr. 1964).

The E2986 thyratron, a commercially produced switch tube with a capacity of 200 megawatts-peak, a mean power level of 150 kilowatts, a 40 kilovolt hold-off voltage, and a peak current rating of 10,000 amp, is described. The deuterium-filled thyratron is now being used in connection with the 50-Mev Proton Linear Accelerator at Harwell. The thyratron is compared with the ignitron. Operating characteristics of the thyratron are described. (R.E.U.)

18512 HELICITY AND TRANSVERSE MOMENTUM OF AN EXTREMELY RELATIVISTIC FERMION IN A CIRCULAR ACCELERATOR. EFFECT OF THE VERTICAL LIMITATION OF THE BEAM. Olivier Costa de Beauregard (Institut Henri Poincaré, Paris). Compt. Rend., 258: 1745-8(Feb. 10, 1964). (In French)

The solution with cylindrical symmetry of the two-component neutrino equation, subjected to a purely tangential potential, independent of time, of the form $A_\theta = a(r)$, is considered by generalizing the previous results (Compt. Rend., 256: 4608(1963) and Compt. Rend., 257: 3327(1963)). The radial distribution is particularized in order to facilitate the discussion of the vertical distribution. The calculations proved the existence of the "inertial effect of spin," independently of the choice of the position operator of the fermion. (J.S.R.)

18513 ORNL 86-IN.-CYCLOTRON FACILITY FOR ISOTOPE PRODUCTION. J. J. Pinajian and T. A. Butler. Isotopes Radiation Technol., 1: No. 2, 137-43(Winter 1963-64).

The ORNL 86-in. cyclotron, which has an important function of producing neutron-deficient radioisotopes, is described. Flat-plate, capsule, and winter targets for the internal beam and T-position and 15°- and 0°-position targets for the deflected beam are described. The cyclotron has a maximum proton-beam current of 2600 μa. The proton energy range is from 17 to 23 Mev. (M.C.G.)

18514 THE CHANGE IN THE ACTION INTEGRAL FOR NEARLY ADIABATIC SYSTEMS. A. J. Lichtenberg (Univ. of California, Berkeley). J. Nucl. Energy, Pt. C, 6: 135-45(Mar.-Apr. 1964).

The asymptotic method for calculating the change in the

action integral for a one-dimensional linear system, with discontinuous derivative in a parameter, is extended to include two varying parameters. This allows for the treatment of relativistic systems in which the mass, as well as the force, varies. The limits of validity of the asymptotic expansion are discussed and it is shown by an example that the number of valid terms of the expansion can be quite limited in practical cases. A particular variation of parameters, which insures that the expansion is valid to the same number of terms for all times during the variation, is treated in detail. It is shown by an exact calculation for a particular variation of this type, that the asymptotic series gives the correct change in action. The results are quite useful for the design of a nearly adiabatic transition region, such as the bunching section of a linear accelerator. (auth)

18515 STUDY OF THE STABILITY OF THE MOTION OF A RADIATING ELECTRON IN THE LINEAR APPROXIMATION: APPLICATION TO STORAGE RINGS. Francis Fer (Laboratoire Joliot-Curie de Physique Nucleaire, Orsay, France). J. Phys. (Paris), 24: 1078-88(Dec. 1963). (In French)

The stability and dampening of horizontal and vertical oscillations were investigated with due consideration of radiation from the electrons. Coefficients for amplification or dampening of the oscillations were obtained. The results were applied to a storage ring with an energy band between 200 and 1300 Mev. The energy dissipation was calculated, and the different dampening coefficients were examined. (D.C.W.)

18516 THE PROBLEMS IN PLANNING THE CONSTRUCTION OF THE HIGH ENERGY ACCELERATOR. [PART] I. Shu Ono (Tokyo Univ.) and Yoichi Fujimoto. Kagaku (Tokyo), 33: 295-9(June 1963). (In Japanese)

The planning of a construction program for a 12-Bev proton synchrotron costing 20,000 million is discussed. The purpose of the accelerator is to provide a more accurate research tool. Construction of an electron synchrotron is planned to provide technical information. The nature of the research institute where the accelerator will be installed has not been decided. The type of personnel needed for the planning team is considered. (from NSA of Japan)

18517 THE PROBLEMS IN PLANNING THE CONSTRUCTION OF THE HIGH ENERGY ACCELERATOR. [PART] II. Shu Ono (Tokyo Univ.) and Yoichi Fujimoto. Kagaku (Tokyo), 33: 364-9(July 1963). (In Japanese)

A construction program for a high-energy accelerator as part of a future nuclear-physics program was recently approved by the Japanese government. Research and development must be organized to carry out this large-scale program. A nation-wide collective organization for physics research is being considered, but nation-wide organizations may result in over-centralization. Care must be taken to preserve the independence of the physicists in the research organization. (from NSA of Japan)

18518 HIGH-TEMPERATURE HYDROGEN ISOTOPE TARGETS. R. Redstone and M. C. Rowland (Services Electronics Research Lab., Baldock, Herts, Eng.). Nature, 201: 1115-26(Mar. 14, 1964).

The use of Nd and Pr deuterides and tritides for high-temperature hydrogen isotope targets was investigated, and the results were compared with those on Zr or Ti films. Results of dissociation pressure as a function of composition for the Nd-H system showed that for atomic ratios of hydrogen to metal up to 1.9:1, NdH is thermally much more stable than TiH. Plots of log dissociation pressure versus the reciprocal of temperature for $NdH_{1.9}$, $PrH_{1.9}$, $TiD_{1.5}$, and $ZrD_{1.45}$ show that at 500°C the dissociation pressure of $NdH_{1.9}$ is about 6 orders of magnitude less than that of $TiD_{1.5}$ and about 4 orders of magnitude less than that of $ZrD_{1.45}$. The results indicate that a target of composition $NdH_{1.9}$ should withstand temperatures at least 200°C higher than the target based on Ti or Zr. (P.C.H.)

18519 A GRAPHICAL FIRST-ORDER TREATMENT OF DISPERSIVE MAGNETIC PARTICLE OPTICS PROBLEMS. H. B. Knowles (Yale Univ., New Haven). Nucl. Instr. Methods, 25: 29-39(Dec. 1963).

A technique for obtaining graphical solutions to magnetic particle optics problems is described for the cases of quadrupole magnets and uniform-field and (special) nonuniform-field bending magnets, including the effects of oblique entrance and exit angles. A method of including first-order momentum dispersion in the bending magnets is developed. The classical construction methods of the geometrical optics of thin lenses are employed. Application of the technique is shown for a few magnetic systems. (auth)

18520 PHASE FOCUSING FOR ISOCHRONOUS CYCLOTRONS. F. M. Russell (Oak Ridge National Lab., Tenn.). Nucl. Instr. Methods, 25: 40-4(Dec. 1963).

The effect upon the phase of ions in a cyclotron of time and space dependent radial forces produced by nonradial accelerating gaps is examined. This topic is relevant to the design of large isochronous cyclotrons. It is shown that with differential variation of gap voltage with radius in adjacent gaps it is possible to exercise control over the phases of ions in a desirable way. Deliberate exploitation of this principle by use of special electrodes is examined and indicates the feasibility of varying the distribution in phase of ions in a cyclic machine. (auth)

18521 AN ION SOURCE FOR POLARIZED PROTONS AND DEUTERONS. E. R. Collins, H. F. Glavish, and S. Whineray (Univ. of Auckland, N. Z.). Nucl. Instr. Methods, 25: 67-76(Dec. 1963).

A source of polarized ions has been constructed which produces a 0.2 μA beam, with good ion-optic quality, of either polarized protons or deuterons. (auth)

18522 THE THIRD ORDER ABERRATIONS OF AN ELECTRIC STRONG FOCUSING DOUBLET. H. M. Loebenstein and A. Sprinzak (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Instr. Methods, 25: 162-70(Dec. 1963).

By expanding the transfer matrices, the 3rd order aberrations of an electric strong focusing doublet are calculated for the nonrelativistic case. The rectangular model for the electric field is assumed in the calculations. (auth)

18523 A POSSIBILITY FOR CURRENT INCREASES IN AN ELECTRON SYNCHROTRON. A. Paulin (DESY, Hamburg). Nucl. Instr. Methods, 25: 181-2(Dec. 1963). (In German)

The desirability of a constant acceleration vector in the electric field of an electron synchrotron at high currents is discussed. Parameters available for influencing particle dynamics, and perhaps applications to oscillation damping at the beginning of acceleration and to increasing beam current, are described. (M.C.G.)

18524 INFLUENCE OF THE COATING RESISTANCE ON THE ELECTRON CAPTURE PROCESS. L. Gonella (Università, Turin and Instituto Nazionale di Fisica Nucleare, Turin). Nucl. Instr. Methods, 25: 183-4(Dec. 1963).

The nonexistence of systematic variations of electron capture in donut-shaped accelerators with wall resistances or transient bumps is suggested. (T.F.H.)

18525 STATE OF DEVELOPMENT OF THE DESIGN OF THE STORAGE RING FOR HIGH ENERGY ELECTRONS AND POSITRONS (ADONE PROGRAM). F. Amman, R. Andreani, M. Bassetti, et al. (Laboratori Nazionali di Frascati, Rome). Nuovo Cimento (1), 1: Suppl. No. 1, 179-91 (1963). (In Italian)

The present design of the Adone storage rings is described in detail. As an introduction the principle of operation of a storage ring is briefly reviewed. The effects of space charge in a storage ring are discussed. The design of the Adone injector, magnet and magnetic structure, injection optics, pulsed deflector, vacuum chamber, and r-f installation is described. (J.S.R.)

18526 THE 250-Mev STORAGE RING (AdA)—RECENT DEVELOPMENTS. C. Bernardini (Laboratori Nazionali, Frascati, Italy), U. Bizzarri, G. F. Corazza, G. Di Giugno, G. Ghigo, M. Puglisi, R. Querzoli, F. Lacoste, P. Martin, and B. Touschek. Nuovo Cimento (1), 1: Suppl. No. 1, 192-8(1963). (In Italian)

The principal characteristics of AdA are briefly summarized. The experiments in course with the Orsay linear accelerator are described. The apparatus and principles for study of the reactions $e^+ + e^- \rightarrow \gamma + \gamma$ and $e^+ + e^- \rightarrow \mu^+ + \mu^-$ are discussed. (J.S.R.)

18527 EFFECTS OF THERMAL VELOCITY ON ELECTRON BEAM MAGNETIC FOCUSING. L. E. Bakhrakh and V. G. Medoks. Radiotekhn. i Elektron., 9: 126-31(Jan. 1964). (In Russian)

Effects of transverse thermal electron velocities in magnetic focusing of cylindrical and band-shaped electron beams were evaluated considering space charge forces for any arbitrary degree of cathode screening. (tr-auth)

18528 INVESTIGATION OF TRAVELING-WAVE SEPARATORS FOR THE STANFORD TWO-MILE LINEAR ACCELERATOR. O. H. Altenmueller, R. R. Larsen, and G. A. Loew (Stanford Univ., Calif.). Rev. Sci. Instr., 35: 438-42(Apr. 1964).

Two traveling-wave r-f structures, which are prototypes of devices to separate mass components of multi-Bev particle beams, have been designed and fabricated. Deflection characteristics have been studied by measuring the deflection of a 40-Mev electron beam. (auth)

18529 FIRST- AND SECOND-ORDER MAGNETIC OPTICS MATRIX EQUATIONS FOR THE MIDPLANE OF UNIFORM-FIELD WEDGE MAGNETS. K. L. Brown (Stanford Univ., Calif.), R. Belbeoch, and P. Bounin. Rev. Sci. Instr., 35: 481-5(Apr. 1964). (SLAC-PUB-19)

The first- and second-order matrix equations for the magnetic optics of the midplane of uniform-field wedge magnets have been derived. The calculations include rotated input and output wedges and curved surfaces on the input and output faces. A second-order matrix algebra has been developed to handle beam transport optics for multiple element systems in a manner similar to that which has been used in the past for the first-order beam transport optics. (auth)

18530 EXTERNAL BEAM CROSS SECTION DISTRIBUTION DISPLAY. J. G. Cottingham (Brookhaven National Lab., Upton, N. Y.). Rev. Sci. Instr., 35: 517-18(Apr. 1964). (BNL-7544)

An intensity locus generator was developed for observing rapidly the position and focal properties of external beams at the Cosmotron. The generator uses a camera video, two amplitude discriminators, and a television monitor. The discriminator outputs are displayed on the monitor as a black dot marking the peak beam intensity and a black contour line marking the locus of 50% intensity. A horizontal sweep synchronized ramp is used to compensate the tilt of the video output. (D.L.C.)

18531 TEILCHENBESCHLEUNIGER. (Particle Accelerator). Rudolf Kollath. Braunschweig, Ger., Friedr. Vieweg & Sohn, 1962. 344p. DM 42.

Properties and production of accelerated particles are discussed, and the development of accelerators is reviewed. The design and modes of operation of betatrons, electron synchrotrons (phase–focusing), microtrons, classic cyclotrons, synchrocyclotrons, proton synchrotrons with weak focusing, isochronous cyclotrons, A-G electron synchrotrons, A-G proton synchrotrons, and linear accelerators are described. Theoretical considerations of acceleration with azimuthally varying magnetic fields are presented. Further developments in accelerator design are surveyed. Uses of particle accelerators are outlined. (M.C.G.)

18532 EXTRACTOR FOR HIGH ENERGY CHARGED PARTICLES. G. R. Lambertson (to U. S. Atomic Energy Commission). U. S. Patent 3,128,405. Apr. 7, 1964.

A particle-extracting apparatus for use with a beam of high-energy charged particles such as travel in an evacuated chamber along a circular equilibrium axis is described. A magnetized target is impacted relatively against the beam whereby the beam particles are deflected from the beam by the magnetic induction in the target. To this end the target may be moved into the beam or the beam may coast into the target and achieve high angular particle deflection and slow extraction. A deflecting septum magnet may additionally be used for deflection at even sharper angles. (AEC)

Astrophysics and Cosmology

18533 (AFCRL-63-674) RESEARCH IN MAGNETOHYDRODYNAMICS AND ITS ASTROPHYSICAL APPLICATIONS. Final Report, June 1963. Max Krook (Harvard Univ., Cambridge, Mass. Harvard Coll. Observatory). Contract AF19(604)-4545. 10p. (AD-414494)

The immediate aims were to study fundamental magnetohydrodynamic behavior and to evolve more efficient methods for solving the atmospheric structure equations. An effort was made to construct dynamical models for stellar atmospheres and, in particular, dynamical models for transient phenomena in such atmospheres. (auth)

18534 (CONF-455-1) IS THE SCORPIUS SOURCE A CLOUD OF 30-Mev ELECTRONS? G. Clark, M. Oda, and J. Overbeck (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). [Mar. 30, 1964]. Contract [AT(30-1)-2098]. 6p.

From Symposium on Neutron Stars and Celestial X-ray Sources, Washington, D. C., Mar. 1964.

The hypothesis that the Scorpius x-ray source is a cloud of energetic cosmic electrons producing recoil x-ray photons by Compton scattering of starlight is discussed. (D.C.W.)

18535 (NP-13715) OPTICHESKII METOD RAZVEDKI ANTIVESHCHESTVA VO VSELENNOI. (An Optical Method of Exploring Antimatter in the Universe). N. A. Vlasov (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoĭ Energii). 1963. 7p.

A mixed region of matter and antimatter in the universe was explored using positronium and protonium infrared and visual emissions. The advantage of the method as compared to γ-astronomy is that the observations are made with ground instrumentation with strong light power and good angular resolution. (tr-auth)

18536 VARIATION OF THE GRAVITATIONAL CONSTANT AND THE EVOLUTION OF THE SUN. P. Pochoda and M. Schwarzschild (Princeton Univ., N. J.). Astrophys. J., 139: 587-93(Feb. 15, 1964).

Evolutionary model sequences were computed for the sun under various assumptions for the possible variation of the gravitational constant G. For these computations G was taken to vary proportionally to the reciprocal of the power n of the time. For the age of the universe, T, values ranging from 8 to 15 billion years were used. It was assumed that 4.5 billion years ago the sun was in its initial main-sequence state. It was found that a mild variation of G, corresponding to n = 0.2, produces no difficulty for the representation of the observed sun as the end product of an evolution starting with the initial main-sequence state and lasting for 4.5 billion years. In contrast, a strong variation of G, corresponding to n = 1.0, permits a satisfactory representation of the present sun only if the age of the universe is about 15 billion years or more. This limitation arises from the circumstances that with a shorter age of the universe the initial main-sequence state of the sun falls relatively earlier in the history of the universe when G, under the present assumptions, was still rather high; this causes so large an initial luminosity of the sun as to lead to an exhaustion of the hydrogen in the solar core and an evolution off the main sequence before 4.5 billion years would have elapsed. (auth)

18537 TERMINATION OF THE PROTON-PROTON CHAIN IN STELLAR INTERIORS. Peter D. Parker, John N. Bahcall, and William A. Fowler (California Inst. of Tech., Pasadena). Astrophys. J., 139: 602-21(Feb. 15, 1964).

The roles of the various ^{2}H- and ^{3}He-burning reactions in the termination of the proton-proton chain in stellar interiors were re-examined using (1) recent experimental determinations of the cross sections for the $^2H(p,\gamma)^3He$ and $^3He(\alpha,\gamma)^7Be$ reactions, (2) theoretical studies of the rates of the relevant beta-decay reactions, and (3) a re-examination of the previous cross section factor determinations for the other possible reactions in the proton-proton chain. 38 references. (auth)

18538 TERMINATING THE PROTON-PROTON CHAIN AT HIGH DENSITIES. John N. Bahcall and Richard A. Wolf (California Inst. of Tech., Pasadena). Astrophys. J., 139: 622-36(Feb. 15, 1964).

The rate of the $^3He(e^-,\nu)^3H$ reaction is calculated as a function of stellar temperature and density using the modern theory of nuclear beta decay. Three tritium-burning sequences of nuclear reactions are also studied. Some possible applications are discussed briefly. 22 references. (auth)

18539 COSMORADIOGENIC CHRONOLOGIES OF NUCLEOSYNTHESIS. Donald D. Clayton (California Inst. of Tech., Pasadena). Astrophys. J., 139: 637-63 (Feb. 15, 1964).

New methods for using radioactive decays to date the time of nucleosynthesis in out galaxy are presented in this work. The methods depend upon a comparison of the cosmoradiogenic abundances of daughter species with the abundances of their radioactive parents. The decays which can provide useful information of this type are $^{187}Re-^{187}Os$, $^{235}U-^{207}Pb$, and $^{238}U-^{206}Pb$. It is shown that the amount of the enrichment of the daughter products by radioactive decay throughout the history of our galaxy is calculable. This calculation differs from previous radioactive chronologies that have concentrated on the relative abundances of the radioactive species themselves, ^{235}U, ^{238}U, and ^{232}Th. Definitive numerical calculations at the present time are forestalled by uncertainties in several key measurable quantities, particularly neutron-capture cross sections and solar abundances. Tentative calculations based on probable values of these quantities indicate that galactic nucleosynthesis began at least 5×10^9 years before the formation of the solar system, and perhaps considerably earlier. Measurements capable of reducing the uncertainty of these methods are emphasized. (auth)

18540 THE BEHAVIOR OF SHOCK WAVES IN A GRAVITATIONAL ATMOSPHERE. G. A. Bird (Univ. of Sydney). Astrophys. J., 139: 675-83(Feb. 15, 1964).

The effects produced by the variations in properties of a gravitational atmosphere on a shock wave propagating within it are determined by an approximate analytical method. Expressions are presented for the rate of change of the shock strength with distance in plane, cylindrical, and spherical atmospheres with or without steady-mass motions, and with arbitrary distributions of temperature and composition. The special cases of the propagation of strong or weak shock waves in adiabatic or isothermal atmospheres are treated. (auth)

18541 A GAS-DYNAMIC MODEL OF THE OUTER SOLAR ATMOSPHERE. G. A. Bird (Univ. of Sydney). Astrophys. J., 139: 684-9(Feb. 15, 1964).

Consideration is given to an atmosphere that is heated by the periodic passage of shock waves. A qualitative physical argument suggests that the atmosphere is likely to be in a state such that it has little effect on the strength of the shock waves. This constant shock-strength hypothesis is used as the basis of a model of the outer solar atmosphere, starting near the base of the chromosphere. The model correctly predicts the magnitude as well as the average gradient of the coronal temperature rise. Details are given of the resulting density and mass-flow distributions. (auth)

18542 DYNAMICAL PROPERTIES OF STELLAR CORONAS AND STELLAR WINDS. III. THE DYNAMICS OF CORONAL STREAMERS. E. N. Parker (Univ. of Chicago). Astrophys. J., 139: 690-709(Feb. 15, 1964).

Observations suggest that the solar corona may consist of thin radial filaments and streamers, rather than being an amorphous atmosphere. The filaments and streamers presumably are confined by the magnetic field, along whose lines of force they lie. To investigate the consequences of a filamentary corona for the solar wind, the dynamics of an idealized corona composed of gaseous streamers, with vacuum between the streamers, is worked out neglecting solar rotation, etc. The principal conclusions are that the streamers occupy most of space at large radial distance from the sun, no matter how small a fraction they may occupy at the sun; the velocity of the solar wind is not greatly affected by filamentary structure for a given coronal temperature distribution; the mean-wind density is not affected by more than a factor of 2. Altogether, then, except for the presence of some thin interstreamer regions, there is no great effect of a filamentary structure on the mean values of the solar-wind velocity and density at large distance from the sun. The possibility of instability of coronal streamers is looked into, and it is shown that, if the corona is composed principally of streamers, the Helmholtz instability may be expected to disorder and mix up the streamer and interstreamer regions beyond some distance (1 a.u.) from the sun, which might be the origin of some of the disorder observed by Mariner. More quantitative observational information of the solar corona and/or of the structure of

the solar wind close to the sun will have to be available before quantitative statements can be made concerning the role of streamers in the solar wind. (auth)

18543 THE SHAPE OF CORONAL-LINE PROFILES. Donald E. Billings (Univ. of Colorado, Boulder and High Altitude Observatory, Boulder, Colo.). Astrophys. J., 139: 710-22(Feb. 15, 1964).

Line profiles are distorted from Gaussian in a characteristic manner if the matter is undergoing either harmonic oscillation or radial flow in cylindrical structures. They are distorted in the opposite sense by a distribution of temperatures along the line of sight. Examples of both types of distortion are found in profiles that were studied, the former appearing to predominate in small, sharp features; the latter is larger and more diffuse features in the corona. The study, although inconclusive, illustrates the possibility of separation of thermal from macroscopic motion if coronal-line profiles of sufficient precision are available. (auth)

18544 NUCLEAR PROCESSES IN CHROMOSPHERIC FLARES. B. M. Vladimirskii and A. B. Severnyi. Izv. Krymsk. Astrofiz. Observ., 29: 80-5(1963).

Flare activity on the sun can cause changes of chemical elements in the solar atmosphere when the flares are heated to thermonuclear temperatures. The elements D, Li, Be, and B can be burned off and formed again in nuclear processes. In each cubic centimeter during a strong flare, 10^4 deuterium nuclei burn off. The total deuterium of the solar atmosphere may be expended in 5×10^7 years. Alpha particles, which are products of (p,α) reactions, may serve as a source for neutrons resulting from reactions of the type (α,n). A (p,α) reaction can produce 1.5×10^{-4} α-particles in one cubic centimeter during a flare lasting 10^3 seconds. Nuclei of C, N, and O found in the solar component could be fissioned by protons of chromospheric plasma producing neutrons. It is possible that there are radiation belts around the sun like those of the earth. Hydromagnetic oscillations of plasma in the radiation belts cause acceleration of protons. A common concentration of C, N, and O nuclei in comparison with hydrogen is 1.5×10^{-3}. The probability of nuclear collisions resulting in formation of ^{6,7}Li by one proton is about 0.6 nuclei of lithium per cubic centimeter, which is a little more than the burned-off quantity. It was concluded that flare activity influences the contents of light elements in the solar atmosphere. (OTS)

18545 THE EFFECT OF AN INTERPLANETARY MAGNETIC FIELD ON THE SOLAR WIND. David B. Beard (Sandia Corp., Albuquerque, N. Mex.). J. Geophys. Res., 69: 1159-68(Apr. 1, 1964). (TID-18472)

A weak interplanetary magnetic field is shown to be compressed into a boundary layer of high magnetic-field intensity several earth radii deep at the surface of the magnetosphere. Thus, if the solar wind consisted of streams of plasma interspersed with an interplanetary magnetic field, magnetic intensity beyond the magnetopause would be expected to fluctuate for several earth radii from zero to as high as the value at the boundary of the magnetosphere. The compressed field is tangential to the boundary and, in general, unrelated in direction to the field inside the boundary. Both conclusions are in agreement with satellite measurements. Particles in the solar wind travel smoothly around to the dark side of the earth where their pressure and the compressed interplanetary magnetic pressure may be expected to close the hollow the geomagnetic field creates in the solar wind. (auth)

18546 VARIATION OF THE LUNAR ATMOSPHERE WITH THE STRENGTH OF THE SOLAR WIND. F. L. Hinton and D. R. Taeusch (Univ. of Michigan, Ann Arbor). J. Geophys. Res., 69: 1341-7(Apr. 1, 1964).

A simplified model of the lunar atmosphere is used to calculate average densities of seven different neutral gases and their ionized components, near the moon's surface, as a function of the solar corpuscular flux J. The method of calculation takes into account, in a unified way, the effect of sources of gas in the lunar crust as well as accretion by the solar wind, and the escape of gases by thermal evaporation and photoionization as well as interaction with the solar wind. For $10^7/cm^2$ sec $< J < 10^9/cm^2$ sec, the main constituents of the lunar atmosphere are argon, constant at about $5 \times 10^4/cm^3$, and neon, which increases linearly with J. For $10^9/cm^2$ sec $< J < 10^{11}/cm^2$ sec, argon and water vapor decrease with increasing J, whereas hydrogen, helium, and neon increase. For $10^{11}/cm^2$ sec $< J < 10^{13}/cm^2$ sec, the densities of argon, neon, hydrogen, and helium take on the approximately constant values (independent of J) of 2×10^3, 2.8×10^5, 3.1×10^5, and $1.5 \times 10^6/cm^3$, respectively. Hence, the total number density of gas from the sources considered will not exceed $2.1 \times 10^6/cm^3$, regardless of how strong the solar flux may become. The densities of krypton and xenon will never be larger than 0.38 and $0.057/cm^3$, respectively. The only gases that contribute appreciably to the ionosphere are neon and argon. (auth)

18547 NEUTRON STARS AS X-RAY SOURCES. Donald C. Morton (Princeton Univ., N. J.). Nature, 201: 1308-9(Mar. 28, 1964).

An attempt is made to explain previously discovered celestial x-ray sources. A neutron star radiating as a black body is suggested as a possible source. Calculations of the atmospheric properties of a neutron star to determine the surface temperature and cooling time are reported. (C.E.S.)

18548 A REVISED SOLAR MODEL WITH A SOLAR NEUTRINO SPECTRUM. Philip Pochoda (Princeton Univ., N. J.) and Hubert Reeves. Planetary Space Sci., 12: 119-26(Feb. 1964).

Improved formulas for the nuclear energy generation rate, together with the Los Alamos opacity code, are used to reanalyze the solar interior. The behavior of the sun in the last 4.5 billion years is displayed. The solar neutrino spectrum is obtained and the hope of detecting neutrinos from the sun is discussed. (auth)

18549 ON THE POSSIBILITY OF SUPERCONDUCTIVITY IN STELLAR MATTER. D. S. Kothari and F. C. Auluck (Univ. of Delhi). Proc. Natl. Inst. Sci. India, Pt. A, 28: 228-9(Mar. 26, 1962).

It is concluded that superconductivity is possible in stellar interiors. The relation between critical density and temperature is tabulated for Z = 10 and 26. (T.F.H.)

18550 TIME SYMMETRIC ELECTRODYNAMICS AND THE ARROW OF TIME IN COSMOLOGY. F. Hoyle (St. John's Coll., Cambridge, Eng.) and J. V. Narlikar. Proc. Roy. Soc. (London), Ser. A, 277: 1-23(Jan. 7, 1964).

A correlation between the local arrow of time given by the electromagnetic radiation and the cosmological arrow of time given by the expansion of the universe is attempted. The Wheeler-Feynman absorber theory of radiation is applied to the expanding cosmological models. First, it is shown that the Schwarzschild-Tetrode-Fokker principle of direct interparticle action can be extended to the general Riemannian space-time. This generalization is considerably simplified in the conformally flat spaces—as all the

Robertson-Walker spaces are. In the application of the absorber theory to various cosmological models, the refractive index turns out to play a crucial part. The ambiguities connected with the sign of the imaginary part of the refractive index are resolved if two conditions are fulfilled: (i) a search is made for a self-consistent solution with full retarded (or advanced) solutions, (ii) in an elementary theory the origin of the imaginary part of the refractive index is traced to the radiative reaction itself and not to the collisional damping considered by Hogarth. It is shown that full retarded solutions are consistent in the steady-state cosmology and full advanced solutions in the Einstein-de Sitter cosmology. Full advanced solutions are not consistent in the former and full retarded solutions in the latter. Some interesting implications of this result in the C-field approach to the steady-state cosmology are considered. (auth)

18551 NEUTRINO RADIOACTIVITY AND ITS ROLE IN ASTROPHYSICAL PROCESSES. V. N. Baier and I. B. Khriplovich (Inst. of Nuclear Physics, Academy of Sciences, Siberian SSR). Soviet Astron. AJ (English Transl.), 7: 599-600(Mar.-Apr. 1964).

Neutrino radioactivity (NR), i.e., nuclear transitions involving emission of a neutrino and an antineutrino, is discussed. The probability of this transition and its role in stellar evolution are evaluated. At $T \sim 10^{9°}$, neutrino emission due to NR can carry away energy from a star comparable to the energy released in nova and supernova outbursts. (auth)

18552 THE ROLE OF RADIATION PRESSURE IN THE DYNAMICS OF PLANETARY NEBULAE. G. S. Khromov (Shternberg State Astronomical Inst., USSR). Soviet Astron. AJ (English Transl.), 7: 609-14(Mar.-Apr. 1964).

The problem of the role of radiation pressure in an expanding planetary nebula of constant mass is considered. According to the model adopted, the nebula is assumed to be a spherical layer whose thickness is one-tenth the outer radius and that expands at a constant velocity. The importance of the fact that the nebula must consist, in its early evolutionary stages, of a tenuous H II zone surrounded by a thick envelope of neutral gas is underlined. Some comparative estimates are offered for the total momentum I_r of the L_α-emission field as a function of the nebular age t, the gas-kinetic momentum I_k, and the nebular expansion momentum I_e. It is demonstrated that the momentum associated with the field of L_α-photons is consistently several orders of magnitude less than the other two contributors throughout the lifetime of the nebula. Thus, the inference that light pressure plays no prominent role in the dynamics of planetary nebulae follows. Results for three different nebular masses are found to be independent of distance scale. (auth)

18553 THE FREQUENCY SPECTRUM OF THE SLOWLY VARYING COMPONENT OF SOLAR RADIO EMISSION. V. V. Zheleznyakov (Gor'kii State Univ., USSR). Soviet Astron. AJ (English Transl.), 7: 630-8 (Mar.-Apr. 1964).

The observed frequency spectrum of the slowly varying component of solar radio emission (with a distinct intensity maximum at $\lambda \sim 5-8$ cm) is explained on the basis of combined action of bremsstrahlung and synchrotron mechanisms in regions of increased density above the center of activity. It is impossible to explain the spectral and polarization features of the s-component in terms of only the bremsstrahlung emitted by coronal electrons, although at millimeter wavelengths and the short-wave side of the centimeter range radio emission above flocculi with $T_{eff} \ll 10^6$ K is apparently of bremsstrahlung origin with intensity independent of the wavelength. In the region of longer wavelengths, i.e., $\lambda > 3$ cm, and especially near the intensity maximum ($\lambda \sim 5-8$ cm), the synchrotron radiation of elec trons moving in the magnetic field of sunspots in layers with frequencies $\omega \propto 2\omega_H$, $3\omega_H$ (ω_H – gyrofrequency) becomes very important. It is possible that synchrotron radiation plays an appreciable role at the beginning of the decimeter region. More definite conclusions on the relative contribution of bremsstrahlung and synchrotron radiation in this wavelength interval to the s-component can be made only after precise measurements of the intensity of the s-component were made in the millimeter region, as the latter in fact determines the level of bremsstrahlung also at longer wavelengths. (auth)

18554 THE MECHANISM OF TYPE II BURSTS OF SOLAR RADIO EMISSION. S. B. Pikel'ner and M. A. Gintsburg (Shtenberg State Astronomical Inst., USSR and Inst. of Terrestrial Magnetism, Ionosphere, and Radio, Academy of Sciences, USSR). Soviet Astron. AJ (English Transl.), 7: 639-42(Mar.-Apr. 1964).

Type II bursts are formed by plasma waves. The generation of plasma waves is possible only if the drift velocity of electrons is greater than the thermal velocity. This condition is not fulfilled for a regular corpuscular stream. However, it can be fulfilled for drift motion of electrons in a collisionless shock-wave front. Estimates show that in this case radio emission with an intensity of the order of that observed can originate. Similar emission is generated in a shock wave due to motion of the stream relative to the earth. The plasma waves formed can accelerate the particles of the radiation belts. (auth)

18555 TWO-BODY MOTION WITH CORPUSCULAR RADIATION. T. B. Omarov (Astrophysical Inst., Academy of Sciences, Kazakh SSR). Soviet Astron. AJ (English Transl.), 7: 707-11(Mar.-Apr. 1964).

Two bodies are considered in relative motion, each emitting corpuscular radiation isotropically, with the particle trajectories from one component being curved by the gravitational field of the other. Over sufficiently short time spans, one may approximate any mass-variation law by Meshcherskii's first law. If one also assumes the effective velocity of the corpuscular radiation to be constant, the Meshcherskii developable spiral will unwind at the angular rate a qualitatively new property of the motion. It is assumed that whatever the mass-variation law, the effective velocity is proportional to the rate of mass loss in the system. The behavior of the osculating orbital elements is examined; one distinctive property is a secular displacement of the angular distance of pericenter relative to a fixed ascending node. (auth)

18556 THE UNIVERSE OF TIME AND SPACE. A Course of Selected Lectures in Astronomy, Cosmology, and Physics. S. T. Butler and H. Messel, eds. The Commonwealth and International Library of Science, Technology, Engineering and Liberal Studies. Oxford, Pergamon Press and New York, The MacMillan Company, 1963. 291p. $2.95.

Lectures presented at the sixth annual Nuclear Research Foundation Summer Science School for high-school students held at the University of Sydney from January 7 to 18, 1963, are given. Subjects range from the structure and origin of the Universe and the solar system to elementary atomic and nuclear physics, electromagnetism, and an introduction to the theory of relativity. (R.E.U.)

Atomic Physics

18557 (LADC-6046) RELATIVISTIC SELF-CONSISTENT FIELD CALCULATIONS FOR METALLIC CERIUM. J. T. Waber, D. Liberman, and Don T. Cromer (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 21p. (CONF-405-4)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

Relativistic, self-consistent field eigenfunctions for cerium were obtained that satisfy the two Dirac equations with a potential corrected for exchange by Slater's $\rho^{1/3}$ method and for self-interaction by Latter's method. The solutions were obtained subject to appropriate boundary conditions at the surface of a sphere of radius R. Substantial variation of the eigenvalues with R is observed. The effect of configuration was also studied. (auth)

18558 (NP-13718) PEREZARYADKA IONOV KISLORODA S ENERGIEI OT 2 DO 13.3 Mev NA TONKIKH ALUNDOVYKH PLENKAKH. (Charge-Exchange of Oxygen Ions with Energies from 2 to 13.3 Mev in Thin Alundum Films). N. I. Venikov, N. I. Chumakov, and B. I. Khoroshavin (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoĭ Energii and Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoĭ Energii). 1963. 6p.

Concentrations of oxygen ions with various changes were measured as a function of the energy of a beam passing through a thin alundum film. Measurements were taken at beam energies from 2 to 13.3 Mev. (tr-auth)

18559 (TID-20449) THE IONIZATION OF ALKALI IONS BY ELECTRON IMPACT. Quarterly Technical Progress Report No. 5, December 1, 1963–February 29, 1964. J. W. Hooper, E. W. McDaniel, and W. C. Lineberger (Georgia Inst. of Tech., Atlanta. School of Electrical Engineering). Mar. 1, 1964. Contract AT(40-1)-3027. 9p.

Research activities on the measurement of the cross section for ionization of lithium ions by electron impact over an electron energy range extending from threshold (75.6 ev) to 1000 ev are discussed. Construction of the ion source, beam scanners, e/m analyzer, and ion beam Faraday cups is nearing completion and installation of these structures in the ultrahigh vacuum chamber is progressing. Preliminary testing of the components is completed and final checkout of the instrumentation is accomplished. (N.W.R.)

18560 (TID-20470) HIGHER SHELL CORRECTIONS IN STOPPING POWER. Technical Report No. 3. Hans (University of Southern California, Los Angeles). June 21, 1961. Contract AT(04-3)-136. 36p.

The assumptions in the stopping power formula about shell corrections and the average excitation potential/electron of the stopping atom (I) were examined. The use of an energy dependent I-value was shown to be impractical. It was found that higher shell corrections obtained from L-shell corrections through a scaling procedure will give good agreement with experimental data under the use of a constant I-value. (auth)

18561 (WIS-TCI-18) HYPERVIRIAL FUNCTIONS AND THE POSITIVE POWERS OF THE RADIAL COORDINATE OPERATOR IN He AND H^-. Sidney L. Gordon (Wisconsin. Univ., Madison. Theoretical Chemistry Inst.). June 10, 1963. Contract AF33(657)-7311. 36p. (AD-415127)

Ground state He and H^- trial functions are scaled to satisfy the hypervirial relations generated by a family of hypervirial operators These one-parameter hypervirial functions are used to calculate expectation values of positive powers of the radial coordinate operators. The values are also calculated through first order using the perturbation techniques of Dalgarno. The perturbation treatment gives excellent results for He, but is ineffective for H^-. The hypervirial theorem is used to develop a variety of expectation value relations for one- and two-electron central force problems. (auth)

18562 INTERACTION OF FAST ELECTRONS WITH A PLASMA OF VALENCE ELECTRONS OF SOLIDS. M. Croitoru. Acad. Rep. Populare Romine, Studii Cercetari Fiz., 14: 867-82(1963). (In Rumanian)

No single theory was developed for explaining the formation of characteristic spectra, consisting of discrete lines, arising from the electron bombardment of metallic layers. This is primarily due to experimental difficulties, which make it nearly impossible to determine the small differences in the transferred energy. Quite probably most of the characteristic losses observed during the last 30 years in a variety of materials are due to the excitation of the conductivity plasma; some of the losses cannot be attributed to a specific cause. The experimental studies were carried out by means of a magnetic electrostatic analyzer, examination of the strong chromatic aberrations outside of the optical axis of electrostatic lenses with cylindrical symmetry, and by studying the slowing-down potential. Scattered particles were detected by means of fluorescent screen connected to a photomultiplier, the precision of which was further improved by the use of a photographic plate. Although the characteristic spectra of a large number of elements were determined during this period, only in the cases of Be, Na, Mg, Al, and K were the results sufficiently precise to allow the observation of multiple maxima. (TTT)

18563 THE PLURAL SCATTERING OF 20-kev ELECTRONS. V. E. Cosslett and R. N. Thomas (Cambridge Univ., Eng.). Brit. J. Appl. Phys., 15: 235-48(Mar. 1964).

Measurements have been made of the angular distribution of electrons, of initial energy 20 kev, transmitted through films of Al, Cu, and Au of thicknesses corresponding to 3 to 20 elastic scattering acts. In form the distributions agree well, over the measured angular range $7 \times 10^{-3} < \theta < 5 \times 10^{-1}$, with that predicted by the Bothe equations for plural scattering. The absolute values of the scattered intensity in Al and Cu agree closely with those calculated in the thinner films, but are about 40% higher in the thicker films, for $10^{-2} < \theta < 10^{-1}$. Taken together with measurements on carbon, these results support Bothe's plural scattering theory but suggest that certain approximations lead to serious underestimation of the intensity scattered into intermediate angles by relatively thick films. In Au the measured intensities are about twice the calculated values in the main part of the angular range for all thicknesses of films, the most probable explanation being failure of the Born approximation. The mass scattering cross sections S_p, derived from the integrated intensity, are generally lower than predicted values. The discrepancy is less than that found in the conditions of electron microscopy ($\theta < 10^{-2}$ and at 50 to 100 kev), but the variation of S_p with Z is found to be stronger, being approximately proportional to $Z^{1/3}/A$ for films of small and medium thickness. In thicker films, the dependence on Z is much less marked. The atomic screening factors calculated from our results are closer to the values derived from the magnetic susceptibility than to those obtained by the Hartree self-consistent field method. (auth)

18564 STUDY OF THE PHYSICAL FACTORS AFFECTING THE ELECTRON EMISSION PRODUCED BY THE IMPACT OF HIGH-ENERGY MOLECULES ON ME-

TALLIC SURFACES. F. Marcel Devienne, Jean-Claude Roustan, and Jacques Souquet (Faculte des Sciences, Nice). Compt. Rend., 258: 140-2(Jan. 6, 1964). (In French)

The effects of the state of the metallic surface and its cleanness, the nature of the surface, the angle of incidence of the molecular jet, and the nature of the layer of adsorbed gas on the number of electrons emitted with respect to the number of incident particles were studied experimentally. The energy of the molecular beam was varied from 500 to 3000 ev, and targets of Al, Ag, stainless steel, Au, Zn, and Cu were used. The results showed that γ (the number of electrons emitted/number of incident molecules) decreases slowly when the metal plate is exposed to high vacuum; it decreases rapidly when the target is exposed to degassing by ionic bombardment. The value of γ depended on the nature of the surface: Al had the highest γ. In all cases γ increased as a function of the incidence of the molecular beam. The study of the effect of contamination of the metal surface with Ar, O_2, H_2, and He showed that γ varied with the different contaminants. (J.S.R.)

18565 OPTICAL CONSTANTS IN THE X-RAY RANGE. H. R. Philipp (General Electric Co., Schenectady, N. Y.) and H. Ehrenreich. J. Appl. Phys., 35: 1416-19(May 1964).

In conjunction with x-ray transmission data, the integral relation between the refraction index and the absorption coefficient can be employed to extend the range over which optical constants were determined by Kramers-Kronig analysis of reflectance data. The procedure is applied to measurements on aluminum and the optical constants are determined for the energy range 10^{-3} to 10^5 ev. The results are useful in testing some general sum rules. They also permit a comparison of the behavior of the dielectric constant for energies above the K absorption edge with the expected asymptotic behavior. (auth)

18566 DYNAMICS OF REACTIVE COLLISIONS: THE H + H_2 EXCHANGE REACTION. M. Karplus, R. N. Porter, and R. D. Sharma (Columbia Univ., New York). J. Chem. Phys., 40: 2033-4(Apr. 1, 1964).

The results of a direct examination of the collision dynamics that represents the first complete quasiclassical calculation of an atom-molecule (H,H_2) exchange reaction for a realistic potential without restrictive approximations are outlined. The differential and the total cross sections for the reaction are evaluated by integration of the appropriate equations of motion. From the cross sections, rate constants were determined by averaging over the distribution of initial conditions corresponding to particular experimental situations. Analysis of trajectories yielded detailed information concerning the nature of the reactive collision (collision time, configuration in neighborhood of saddle point, dependence of reaction probability on impact parameter). (P.C.H.)

18567 COMPARATIVE IONIZATION BY MILLION-ELECTRON-VOLT HEAVY IONS AND KILOELECTRON-VOLT ELECTRONS. Robert H. Schuler and Fred A. Stuber (Mellon Inst., Pittsburgh). J. Chem. Phys., 40: 2035-6 (Apr. 1, 1964). (RRL-128)

Studies were made on the ionization by protons and helium ions in the Mev region and by electrons in the kev region using a time-of-flight mass spectrometer. The fragmentation patterns produced by 2-Mev protons and electrons of the same velocity (1 kev) were found to be qualitatively very similar for the organic systems examined (methane, acetylene, benzene, carbon tetrachloride, and methyl iodide). In spite of the overall similarity of the patterns produced by protons and electrons slight differences in detail did, however, appear to exist. For example, the relative abundances of the fragment ions produced by the heavy ions were somewhat greater than those produced by the electrons. (P.C.H.)

18568 RELATION BETWEEN THE PHASE SHIFT AND THE EXISTENCE OF NEGATIVE IONS. T. Tietz (Univ. of Lodz, Poland). J. Chem. Phys., 40: 2067-8(Apr. 1, 1964).

Studies on the behavior of the phase shift λ near zero energy indicate the number of bound states m and whether the existence of negative ions is possible or not. Some numerical results for λ_H and λ_K for a neutral carbon atom are tabulated. (P.C.H.)

18569 ON THE CALCULATION OF TWO-ELECTRON MATRIX ELEMENTS OF THE ORBIT-ORBIT INTERACTION OPERATOR. R. Dagys, Z. Rudzikas, R. Katilius, and A. Jucys (State Pedagogical Inst., Vilnius, USSR and Inst. of Physics and Mathematics, Academy of Sciences, Lithuanian SSR). Lietuvos Fiz. Rinkinys, 3: 365-76(1963). (In Russian)

The question of the calculation of two-electron matrix elements of orbit-orbit interaction operators with the help of mathematical apparatus of irreducible tensor operators is discussed. The expressions for the matrix elements in terms of the radial integrals in the case of two-electron configurations sp, sd, pp', pd, and dd' are given. (auth)

18570 INTERSTITIAL ATOMS IN NOBLE METALS. A. Seeger (Max-Planck-Institut für Metallforschung, Stuttgart and Technische Hochschule, Stuttgart). Phys. Letters, 8: 296-7(Mar. 1, 1964).

A discussion is presented on the interpretation of annealing stages of cold-worked, irradiated, and quenched platinum-group metals. 30 references. (R.E.U.)

18571 A NEW SAMPLING METHOD FOR CALCULATING THE FREQUENCY DISTRIBUTION FUNCTION OF SOLIDS. G. Gilat and G. Dolling (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Letters, 8: 304-6 (Mar. 1, 1964).

A sampling method is described for rapid and accurate computation of the frequency distribution function $g(\nu)$ of the normal modes of vibration of a solid from the frequency-wave vector relation obtained from coherent one-phonon scattering of neutrons from single crystals. The method features diagonalization of the dynamic matrix $D(\vec{q})$ for a relatively small number of $\vec{q}$ ($\vec{q}$ is the wave vector of the normal mode) spaced regularly on a "crude mesh." Results for sodium are given. (R.E.U.)

18572 ELECTROSTATICALLY CORRELATED SPIN-ORBIT INTERACTIONS IN l^N-TYPE CONFIGURATIONS. R. Rajnak (Univ. of California, Berkeley) and B. G. Wybourne. Phys. Rev., 134: A596-600(May 4, 1964). (UCRL-11175)

It is shown that, in second-order perturbation theory, electrostatically correlated spin-orbit interactions give rise to a screening of the spin-orbit coupling constant of an l^N-type configuration. In addition to this screening effect, these interactions also lead to an effective spin-other-orbit interaction that is not included in the usual empirical least-squares determination of the Coulomb and spin-orbit parameters. The consequences of this overt effect are discussed. (auth)

18573 NONADIABATIC THEORY OF INELASTIC ELECTRON-HYDROGEN SCATTERING. H. L. Kyle and A. Temkin (Goddard Space Flight Center, Greenbelt, Md.). Phys. Rev., 134: A600-7(May 4, 1964).

The nonadiabatic theory is applied to the inelastic S-wave scattering of low-energy electrons from atomic hydrogen. The zeroth-order (angle-independent) approxi-

mation for excitation of the 2s level from the ground state is described by the same equation used to describe elastic scattering below the 2s threshold, but with more complicated boundary conditions. The solution was effected by expanding the wave function in terms of separable solutions. With the assumption of reciprocity it is also possible to obtain the 2s−2s cross sections. The elastic (1s−1s) cross sections are within 1% of the close-coupling results in the triplet case, but are about 20% greater in the singlet case. The inelastic (1s−2s) cross sections are reduced about 20% in the triplet case and 20 to 40% in the singlet case, relative to the close-coupling results. (auth)

18574 SELF-BROADENING OF OPTICAL DOUBLE RESONANCE LINES IN CADMIUM. F. W. Byron, Jr., M. N. McDermott, and R. Novick (Columbia Univ., New York). Phys. Rev., 134: A615-24(May 4, 1964).

Collision broadening studies were made of optical double resonance lines in cadmium. The results indicate that the collision frequency is velocity dependent, contrary to the usual theory of resonance self-broadening. This result supports the suggestion that the broadening results from interactions involving a number of intermediate states rather than only the initial and final states of the optical transition, because of the small oscillator strength (f = 0.002) for transitions between the $(5s)^2\ {}^1S_0$ ground state and the excited state in question $(5s5p)\ {}^3P_1$. The cross section in this case has a $1/\bar{v}_{12}^{4/5}$ velocity dependence, so the collision frequency varies as $\bar{v}_{12}^{4/5}$. Measurements show that under this assumption the self-broadening cross section for cadmium is $\sigma_{coll} = (1.9 \pm 0.3) \times 10^{-12}\ cm^2/\bar{v}_{12}^{4/5}$, where $\bar{v}_{12}$ is the average relative velocity in cm/sec. The lifetime of the $(5s,5p)\ {}^3P_1$ state was redetermined and found to be $(2.39 \pm 0.04) \times 10^{-6}$ sec. (auth)

18575 THEORY OF COLLISION BROADENING IN THE SUDDEN APPROXIMATION. F. W. Byron, Jr., and H. M. Foley (Columbia Univ., New York). Phys. Rev., 134: A625-37(May 4, 1964).

A method is developed for calculating the cross section for line broadening in the limiting case in which important collisions may be considered to occur very rapidly with respect to the periods corresponding to the transitions in question. This method is essentially an extension of the familiar sudden approximation; reference is made throughout to the particular example of optical double resonance only for definiteness and because there are available experimental results for comparison with the theory. Assuming the impact model and considering the case when the energy levels in question are well resolved with respect to their width, an exact expression is found for resonant self-broadening in the usual weak r-f field limit of interest in double resonance. For the case of very small oscillator strengths for the optical transition (intercombination lines), the resonant broadening becomes sufficiently small so that second-order, intermediate-state processes dominate, and approximations must be made to effect sums over intermediate states. Here the broadening is of the same sort as foreign gas broadening, and in many cases of interest, the approximations can be made in a sufficiently realistic manner to obtain useful expressions for the broadening. It is shown that the resonant cross section and this second-order cross section are not additive, but that the one that is larger dominates the total cross sections very strongly. The self-broadening and foreign gas broadening (by the noble gases) of double resonance lines in the group II metals and the self-broadening in the optical spectrum of helium are evaluated. In all cases the theoretical predictions are in good agreement with measurements. (auth)

18576 ANOMALOUS PENETRATION OF HEAVY IONS OF kev ENERGIES IN MONOCRYSTALLINE TUNGSTEN. B. Domeij, F. Brown, J. A. Davies, G. R. Piercy, and E. V. Kornelsen (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev. Letters, 12: 363-6(Mar. 30, 1964).

An electromagnetic separator was used to bombard single crystals of tungsten with 40-kev ^{135}Xe ions to study the effect of crystallographic orientation on the range distribution of the ions. The results agree with theoretical predictions for bcc lattices. Plots of the residual activity against the depth showed a penetrating "tail" of the range distribution occurring above a few hundred $\mu g/cm^2$ in addition to the main distribution. Two supplementary experiments were performed to study effect of lattice temperature and incident energy along the ⟨100⟩ direction on the tail of the distribution. (L.B.S.)

18577 ANOMALOUS PENETRATION OF RARE GAS ATOMS IN LATTICE CHANNELS. Cavid Erginsoy (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 12: 366-7(Mar. 30, 1964).

The integral penetration curves for 40-kev ^{125}Xe atoms in tungsten was examined. In particular, the large penetrations constituting the "tail" of the range distribution were examined. It is shown that the elastic model of channeling cannot account for the observed large penetrations. (L.B.S.)

18578 SPIN RELAXATION IN SOLID ^3He: OBSERVATION OF EXCHANGE BOTTLENECK. B. T. Beal, R. P. Giffard, J. Hatton, M. G. Richards, and P. M. Richards (Oxford Univ.). Phys. Rev. Letters, 12: 393-6(Apr. 6, 1964).

Use is made of the three-bath model to interpret measurements of longitudinal nuclear spin relaxation in solid ^3He. Evidence that, at low temperatures, the bottleneck in the energy transfer is between an intermediate reservoir and the lattice is presented. Curves for the relaxation time as a function of inverse temperature at molar volumes of 19.0 and 20.0 cm^3 are presented and analyzed. Experimental results for 99.95% pure ^3He are tabulated. Non-exponential recoveries in samples containing 0.5% ^4He following short and long saturation periods were analyzed for all temperatures below 1°K. (L.B.S.)

18579 CONTRIBUTION OF THE DOUBLE ELECTRON TRANSITIONS TO THE SOFT X-RAY EMISSION BANDS OF METALS. J. Pirenne and P. Longe (Université, Liège). Physica, 30: 277-92(Feb. 1964).

The low energy tail of the soft x-ray emission bands of metals is interpreted as due mainly to the double and multiple transitions, the contribution of which seems more important than the effects studied by Landsberg (broadening of the levels by electron collisions) and by Raimes (modification of the level density required by the Bohm-Pines theory). The theoretical treatment is applied to the L_3 band of sodium and use is made of a screened Coulomb potential as was done by Landsberg and as is required by the Bohm-Pines theory. The screening length is determined by the Thomas-Fermi method and gives quite good agreement with observation. Its value is similar to that fixed empirically by Landsberg. The Bohm-Pines screening length on the contrary seems much too high because the tail would then spread over several ev. (auth)

18580 SCATTERING AND THE BOLTZMANN RELAXATION EQUATION. A. M. Guénault and D. K. C. MacDonald (National Research Council, Ottawa). Physica, 30: 309-23 (Feb. 1964).

The Boltzmann relaxation equation, $[\partial P/\partial t]_{scatt.} =$

$-(P - P^{eq}/\tau)$, has considerable popularity for describing the rate of change in time of a distribution function due to scattering. It is examined how far this equation can have general validity for an arbitrary distribution function, P, and its possible utility for solving steady-state transport problems. The behavior of the Rayleigh piston model in both the Brownian movement and Lorentz limits is considered. The results show that, without rather unusual assumptions, one cannot expect scattering to be represented at all generally by the Boltzmann relaxation equation. Moreover when, and if, the Boltzmann relaxation equation is valid the only consistent assumption is that τ, the relaxation time, is strictly constant. (auth)

18581 PHOTON EMISSION BY IONICALLY BOMBARDED COPPER SURFACES. C. Snoek, W. F. van der Weg, and P. K. Rol (FOM-Laboratorium voor Massascheiding, Amsterdam). Physica, 30: 341-4(Feb. 1964).

A study was made of the light emitted by copper surfaces under bombardment with 60-kev Ar^+ ions. Measurements were made on the resonance line of the atomic spectrum of the target material. Angular distributions and the intensity profile of the λ = 3247 Å line are illustrated. (C.E.S.)

18582 SURFACE STRUCTURE OF IONICALLY BOMBARDED COPPER SINGLE CRYSTALS. J. M. Fluit and S. Datz (FOM-Laboratorium voor Massascheiding, Amsterdam). Physica, 30: 345-50(Feb. 1964).

Optical examination of the surface of a (100) Cu single crystal that was bombarded by 20-kev Ar^+ ions revealed structure that was dependent on the incidence angle of the ion beam. For incidence angles corresponding to small ion penetration depth the structure could be explained on the basis of two competing mechanisms; one favoring the development of facets normal to the surface and the other favoring the development of (110) surfaces. Qualitatively different behavior was found when the ion beam was directed at 45° to the surface (corresponding to a [110] crystal direction). This difference was attributed to the large increase in mean penetration depth for this incidence angle. (auth)

18583 ON THE EFFECT OF THE FINITE MASS OF THE PROTON IN LAMB SHIFT IN HYDROGEN ATOM. H. S. Mani and Jaidev Anand (Univ. of Delhi). Proc. Natl. Inst. Sci. India, Pt. A, 28: 244-8(Mar. 26, 1962).

The effect of the finite mass of the proton in the Lamb shift is studied by considering the reduced mass effect and by assuming the proton to have a spread of $\sqrt{2.8}$ times the Compton wavelength. The calculations give a shift of -1.18 Mc. (auth)

18584 IONIZATION OF ATOMIC HYDROGEN BY PROTONS IN THE ENERGY RANGE 60 TO 400 kev. H. B. Gilbody and J. V. Ireland (University Coll., London). Proc. Roy. Soc. (London), Ser. A, 277: 137-41(Jan. 7, 1964).

Ionization of atomic hydrogen by protons has been investigated by means of the crossed beam technique in which a proton beam from a Van de Graaff accelerator was arranged to intersect a modulated beam of atomic hydrogen produced from a furnace source. The ratio of the cross section for ionization of atomic hydrogen to that for molecular hydrogen was determined by comparing the signals due to electrons arising from the interaction region when the beam was mainly atomic and when the beam was entirely molecular. The absolute cross section for ionization of atomic hydrogen by protons was determined from a knowledge of the molecular cross section. (auth)

18585 REARRANGEMENT COLLISIONS: TWO-PARTICLE EXCHANGE. M. H. Mittleman (University Coll., London). Proc. Roy. Soc. (London), Ser. A, 277: 206-13 (Jan. 21, 1964). (UCRL-7494)

It is shown that the first Born approximation for the exchange of two uncorrelated electrons should vanish. A formalism for the T matrix is presented which has this property. The high-energy result for the two-electron exchange cross section previously calculated in first Born approximation behaves like E^{-7}. This result is in error due to a lack of orthogonality of initial and final states. When this is corrected the result for uncorrelated electrons has an energy dependence E^{-11}. The introduction of correlation gives terms behaving like E^{-10} which cannot be calculated unambiguously. (auth)

18586 ELECTRON CORRELATIONS IN NARROW ENERGY BANDS. II. THE DEGENERATE BAND CASE. J. Hubbard (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Roy. Soc. (London), Ser. A, 277: 237-59(Jan. 21, 1964).

A generalization of the theory of correlation effects in narrow s-bands, applicable to narrow degenerate electron bands, is developed. The theory is based on the notion that in the case of narrow bands the most important correlations are those between electrons on the same atom. The solution obtained has the important property of going over into the ordinary band theory solution in the appropriate limit (no interaction) and the exact atomic (Heitler-London) solution in the opposite limit (zero band-width). In order to elucidate the general properties of the solution some simplified models are discussed, and the more elementary implications of the theory when applied to the d-bands of transition metals are indicated. A physical interpretation of the results of the theory is given; the physical picture which emerges is found to be closely related to a theory discussed earlier by Van Vleck. (auth)

18587 RADIATION WIDTH AND RESONANCE BROADENING IN HELIUM. H. G. Kuhn and J. M. Vaughan (Oxford Univ.). Proc. Roy. Soc. (London), Ser. A, 277: 297-311(Feb. 11, 1964).

By means of a direct recording Fabry-Perot interferometer, the contours of several singlet lines of helium were studied over a wide range of pressure and temperature. The source was a microwave discharge cooled with liquid nitrogen or liquid helium. Analysis of the tracings allowed the Doppler and Lorentz components to be separated quantitatively. A detailed study was carried out for the line λ 7281 Å ($2^1P - 3^1S$). By extrapolation of the Lorentz width to zero pressure the radiation width of the level 2^1P was determined and led to an f-value 0.37 ± 0.03 of the resonance line λ 584 Å ($1^1S - 2^1P$). The resonance broadening is found to be independent of the speed of the atoms over a range of a factor five in the speed, in agreement with theories of optical collision by Weisskopf and others. The absolute value of the resonance broadening constant is compared with various theories. The strong line λ 6678 Å ($2^1P - 3^1D$) showed self-absorption due to imprisonment of resonance radiation. (auth)

18588 VIBRATIONAL AND ROTATIONAL TRANSITIONS IN MOLECULAR COLLISIONS. Kazuo Takayanagi (Saitama Univ., Urawa, Japan and Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), Suppl., No. 25, 1-98(1963).

Theoretical studies on the rotational and vibrational transitions in molecular collisions are reviewed. Discussions are mainly concerned with diatomic molecules. A brief historical introduction and a description of the scope of the article are presented. These are followed by introductory remarks on the relaxation times and the intermolecular interactions. Wave-mechanical formula-

tion of the collision problem follows a brief description of the classical treatments. The rotational transitions in hydrogen molecules are discussed with the aid of the distorted wave method. Rotational transitions in other molecules present strong coupling problems, for which suggestions are made for approximate treatment. The vibrational transitions in colinear collisions are discussed in detail. The present situation in the theory of three-dimensional collisions is summarized. 202 references. (auth)

18589 MOLECULAR BEAM SCATTERING AT THERMAL ENERGIES. Richard B. Bernstein (Univ. of Wisconsin, Madison). Science, 144: 141-50(Apr. 10, 1964).

A review is presented on the interpretation of measured angular distributions in terms of differential scattering cross sections in molecular beam scattering at thermal energies. Special attention is given to velocity distributions in the beam and scattering gas. Conversion of data to the center-of-mass system, apparatus, scope of thermal molecular-beam-scattering studies, and recent advances in elastic scattering at thermal energies are discussed. 75 references are included. (P.C.H.)

18590 ENERGY DISTRIBUTION OF SECONDARY ELECTRONS AND PHOTOELECTRONS EXCITED BY SOFT X RAYS. N. G. Nakhodkin and P. V. Mel'nik (Kiev State Univ.). Soviet Phys.-Solid State (English Transl.), 5: 1779-83(Mar. 1964).

With the aid of a Hughes and Rozhanskii type cylindrical condenser the spectra of secondary electrons and photoelectrons excited in evaporated films of Au, Ge, and Cu by primary electrons and x-ray quanta having the same energy of about 1.5 kev were compared. Analysis of the data demonstrates the similarities and differences in the electron spectra corresponding to these effects. It is shown that a considerable number of Auger electrons are present among the photoelectrons. (auth)

18591 DECELERATION AND INELASTIC SCATTERING OF ELECTRONS IN THIN UNSUPPORTED FILMS OF COPPER. I. R. Kanicheva and B. F. Barzdo (Leningrad Polytechnical Inst.). Soviet Phys.-Solid State (English Transl.), 5: 1870-5(Mar. 1964).

A study is made simultaneously of the transmission and scattering of electrons in thin unsupported films of copper for initial electron energies from 2 to 15 kev. The obtained data on absorption of electrons show that in the energy range investigated, absorption of electrons takes place over a wide range of thicknesses. A relation between the maximum penetration range of electrons and their energies is obtained. The result of the study of the thickness dependence of the inelastic scattering in thin unsupported films of copper shows that the participation of layers in the scattering is not uniform. (auth)

18592 THE DIFFERENTIAL AND INTEGRAL CROSS SECTIONS FOR LOSS AND CAPTURE OF ELECTRONS BY ARGON IONS AT 250 ÷ 1400 kev. L. I. Pivovar, M. T. Novikov, and V. M. Tubaev (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 46: 471-81(Feb. 1964). (In Russian)

The energy and angular dependence of the distribution of charge fractions in an argon particle beam are measured for single collisions with argon and krypton atoms. The results agree with the Russek-Thomas theory. The differential cross sections for scattering and electron loss and the integral cross sections for electron loss and capture by singly charged argon ions in argon and krypton are also measured. The measurements are performed in the 0–3° angle range. Those parts of the integral effective cross sections that correspond to scattering of the primary ions into angles between 0 and 1° were measured directly. (auth)

18593 VVEDENIE V TEORIYU ATOMNYKH SPEKTROV. (Introduction into the Theory of Atomic Spectra). I. I. Sobel'man. Moscow, Publishing House of the Academy of Sciences, 1963. 640p.

A systematic account is given of the physical principles and theory of atomic spectroscopy. The excitation and emission of atoms are also discussed. (R.V.J.)

Cosmic Radiation

18594 (NP-13684) SOLAR COSMIC RAY EVENTS AND THEIR INTERPRETATION. PART I. INTRODUCTION. May 1963. PART II. MEASUREMENTS. July 1963. David Reitz (Martin-Marietta Corp. Aerospace Div., Denver). 175p.

Issued in two volumes, but cataloged as a unit.

I. The optical classification of flares, the relations between particle properties (energy, momentum, and rigidity), and charged-particle penetration of the geomagnetic field are examined. Solar generation of cosmic rays is also discussed, and devices for measuring solar cosmic rays are described. II. Observations on solar cosmic ray events during periods of both high and low solar activity are presented chronologically with time variations and spectra when known. 270 references. (D.C.W.)

18595 LARGE ATMOSPHERIC PHOTON JETS. Jerzy Gawin, Julius Hibner, Roland Maze, and Alexander Zawadzki. Compt. Rend., 258: 150-3(Jan. 6, 1964). (In French)

The results of the analysis of events recorded by the hodoscope of Lodz are presented. It is shown that 0.6% of the large γ jets contain 11% of the penetrating particles. These relative values refer to normal jets of the same size. (tr-auth)

18596 WIDTH OF CORPUSCULAR STREAMS CAUSING THE DIURNAL COSMIC RAY EFFECT. A. A. Stepanyan. Izv. Krymsk. Astrofiz. Observ., 29: 126-30 (1963).

An explanation is given for diurnal variations in cosmic ray intensity. Diurnal variations of cosmic rays are explained geometrically by a conic surface with the vertex on the earth and a plane sector with the vertex on the sun. The sector represents the solar corpuscular stream, and the conic surface, the observer's scope. The projection angle of the sector is determined by integrating arc functions based on the angular positions of the sector and the sight line on the conic surface. From these results curves are plotted and compared with observational data. Curves of sector openings of more than 90° agree with observation data. (TCO)

18597 GEOMAGNETIC EFFECTS ON ANISOTROPIC COSMIC RADIATION. Rolf Bostroem (Royal Inst. of Tech., Stockholm). J. Geophys. Res., 69: 1217-32(Apr. 1, 1964).

Two different methods are discussed for taking geomagnetic effects into account when evaluating the counting rate of a cosmic-ray detector for a given anisotropic radiation source. The applicability of these methods is studied, and some properties of the asymptotic cone of acceptance are found by performing the transformation through the geomagnetic dipole field of the infinitely small solid-angle elements that constitute the acceptance cone. A solid angle at the detector is greater than the corresponding asymptotic cone for all latitudes, angles of incidence, and energies except immediately above the geomagnetic cutoff.

This focusing effect is especially good for high-latitude detectors, which thus have the best resolving power. (auth)

18598 A STUDY OF THE RELATIONSHIP BETWEEN ABSORPTION-TIME PROFILES OF POLAR-CAP-ABSORPTION EVENTS AND FORBUSH DECREASES OF COSMIC-RAY INTENSITY. John T. Gosling (Univ. of California, Berkeley). J. Geophys. Res., 69: 1233-8 (Apr. 1, 1964).

Forbush decrease data recorded by neutron monitors during PCA events support the interpretation of the absorption-time profiles of PCA events as due to solar particles under the influence of magnetic fields carried by solar plasma. All PCA events showing evidence of strong trapping of solar particles are accompanied by strong Forbush decreases, the magnitudes of which are a function of the delay time from flare to SC storm. Those PCA events showing little evidence of trapping are accompanied by only very weak decreases. The large western excess of these latter events is explained in terms of sun-earth magnetic linkage set up by earlier flare activity. The relative merits of two models of the interplanetary fields are examined. (auth)

18599 DENSITY OF COSMIC-RAY NEUTRONS IN THE ATMOSPHERE. Ralph F. Miles (California Inst. of Tech., Pasadena). J. Geophys. Res., 69: 1277-84(Apr. 1, 1964).

A new method of measuring cosmic neutrons was developed, yielding a precision (±2 per cent) heretofore unattainable in balloon instrumentation. Ionization chambers using a quartz fiber electrometer of the Neher design and filled with $^{10}BF_3$ detected the neutrons by means of the $^{10}B(n,\alpha)^7Li$ reaction. Ionization chambers filled with $^{11}BF_3$ or argon measured the background current due to the ionizing component of cosmic radiation. Calibration uncertainties and self-shielding effects limited the absolute accuracy of the measurements to ±20 per cent. This method was employed to measure the density of cosmic neutrons in the atmosphere at $\lambda_m = 41°N$ on several balloon flights during 1962. The data from the balloon flights showed a maximum in the neutron density of $4.8 \pm 1.2 \times 10^{-7}$ neutron cm^{-3} at a pressure altitude of 100 g cm^{-2} (53,000 feet), a rapid decline above this altitude, and an exponential decrease below 250 g cm^{-2} with an absorption length of 165 ± 20 g cm^{-2}. There is satisfactory agreement between the results of this experiment and the work of the New York University Cosmic-Ray Group. The measured neutron densities of Hess, et al., are as much as 60 per cent higher than the values obtained in this experiment. (auth)

18600 ORIGIN OF COSMIC RAYS. Hirokazu Hasegawa (Gakushuin Univ., Japan) and Kenya Ito. Kagaku (Tokyo), 33: 403-7(Aug. 1963). (In Japanese)

A meeting on the origin of cosmic rays was held at the Research Institute of Fundamental Physics, Kyoto University, in May, 1963. Results and problems in recent observations on cosmic rays were presented. The energy spectra of cosmic rays, the galaxy, the composition of cosmic rays, Fermi acceralation and supernovae were presented as basic knowledge. The following subjects were discussed: galactic electrons, the secondary electron hypothesis for their origin and its verification by the ratio of positrons to electrons in primary cosmic rays; γ-ray astronomy, its significance, and experimental methods; anisotropy in the arrival directions of heavy nuclei; the new theory of evolution of stars and supernovae by Hayashi et al. and its development; acceleration of cosmic rays, the acceleration mechanism of solar cosmic rays, and its generalization; and extragalactic sources of cosmic rays with special reference to radio galaxies. (from NSA of Japan)

18601 ABSORPTION OF NUCLEAR-ACTIVE COSMIC-RAY PARTICLES IN AIR AND IN A DENSE MEDIUM. Gyoergy Bozóki (Central Physics Research Inst., Budapest). Magy. Fiz. Folyoirat, 11: 351-410(1963). (In Hungarian)

Extending the work initiated by L. Jánossy and his coworkers, high-energy interactions in the 30- to 60-Bev range were investigated by means of a G-M counter assembly, in order to determine the penetrating, medium-energy showers. The absorption lengths in air and in dense mediums, of cosmic particles that generated showers, were evaluated. On the basis of the data obtained, an attempt was made to determine the average inelasticity of the nucleon-nucleus and nucleon-nucleon collisions. Experimental absorption-length measurements were made by means of a shower detector; the value in air was (126 ± 2) g/cm^2. The absorption length of the high-energy nuclear active materials was determined directly by absorption in dense layers; the value for lead was (414 ± 17) g/cm^2, while the absorption length of nuclear-active particles associated with extended showers was (630 ± 77) g/cm^2. The mean free path of the ~30-Bev medium-energy neutrons in carbon was found to be (74 ± 7) g/cm^2. The average inelasticity of the nucleon-air nucleus collisions was $K_L^{nN} = 0.53 \pm 0.02$ and of the nucleon-nucleon collisions $K_C^{np} = 0.52 \pm 0.003$. (TTT)

18602 RADIATION MEASUREMENTS AT SCOTT BASE. D. C. Thompson (New Zealand Meteorological Service, Wellington) and W. J. P. MacDonald. New Zealand J. Geol. Geophys., 5: 874-909(Dec. 1962).

Measurements of long-wave and short-wave radiation of solar and terrestrial origin at Scott Base during the IGY are described. The errors inherent in the observations are discussed. Empirical equations are obtained relating the observed short-wave radiation to the daily hours of sunshine and to the mean cloudiness. These relations differ from the corresponding ones for lower latitudes. Similarly, relations were derived for the long-wave radiation in terms of cloud cover and the surface and maximum tropospheric air temperatures. The measurements of short-wave radiation were compared with theoretical estimates based on radiosonde data and are shown to agree when very small values of the turbidity coefficient are assumed. The albedo of the surface over which the net flux of long-wave and short-wave radiation was measured was studied. Its low value in summer, when much bare rock is exposed, is shown to account for the yearly net income of about 18,000 cal/cm^2 that was recorded, in contrast to the substantial yearly net outgoing radiation recorded over a permanent snow surface at other stations in similar latitudes. (auth)

18603 SEARCH FOR THE DIRAC MONOPOLE. V. A. Petukhov and M. N. Yakimenko (Lebedev Inst. of Physics, Moscow). Nucl. Phys., 49: 87-9(Nov. 1963).

An upper limit of the effective cross section for the production of monopoles by cosmic rays is established ($\sigma < 3 \times 10^{-40}$ cm^2). A method obviating the difficulties connected with the uncertainty of its mass is presented. (auth)

18604 VERY HIGH-ENERGY COSMIC RADIATION. L. Scarsi (Università, Milan and Istituto Nazionale di Fisica Nucleare, Milan). Nuovo Cimento (1), 1: Suppl. No. 1, 220-40(1963). (In Italian)

The recent results obtained in the energy range $>10^{15}$ ev are reviewed with a detailed analysis of the data from observation of extensive showers. The use of the extensive shower as a technique for the study of high-energy cosmic rays is discussed. The variation of the number of particles and the energy spectra of primary particles are considered. The composition of the nucleon component of high-energy

cosmic radiation is given. In conclusion, the distribution of the direction of arrival in galactic coordinates is discussed. (J.S.R.)

18605 COSMIC RADIATION AND PHYSICAL STATE OF INTERPLANETARY SPACE. F. Bachelet (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nuovo Cimento (1), 1: Suppl. No. 1, 241-52(1963). (In Italian)

The problems in the correct deduction of the properties of primary cosmic radiation in the vicinity of the earth, but outside the magnetosphere, from the properties of cosmic radiations recorded within the geomagnetic field and within the terrestrial atmosphere are discussed. Some recent results obtained from the study of the intensity variations measured at various heights and on various components are reported. (J.S.R.)

18606 HEAVY PRIMARY COSMIC-RAYS DURING 1957. O. B. Young and J. W. Lieh (Southern Illinois Univ., Carbondale). Nuovo Cimento (10), 31: 974-7(Mar. 1, 1964).

Heavy primary cosmic ray results during the year 1957 for G. M. latitude of 41°N, based on a Texas balloon flight that exposed Ilford G.5-G.0 combination emulsions at about 130,000 feet are discussed. A flux value for $Z \geq 10$ at the top of the atmosphere of $(2.40 \pm 0.29) \times 10^{-4}$ particles/cm^2 s sr was found. Thus a new point is established on the 8-year incomplete curve of a previous paper. The charge spectrum, mean free path, and angular distribution are also included. (auth)

18607 FORMATION OF HIGH ENERGY γ QUANTA IN EXTENSIVE AIR SHOWERS WITH ENERGIES $10^{14}-10^{15}$ ev IN THE UPPER THIRD PART OF THE ATMOSPHERE. R. A. Antonov, Yu. A. Smorodin, and Z. I. Tulinova (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 46: 28-35(Jan. 1964). (In Russian)

Experimental data on the energy spectra of γ quanta in extensive air showers containing 10^5-10^6 particles are obtained for $10^{12}-10^{13}$ ev quanta at depths of 311 and 197 g/cm^2 in the atmosphere. The multiplicity of pion production in interactions involving particles with energies $\sim 10^{15}$ ev calculated on basis of these data appreciably exceeds that predicted by the Landau theory. The degree of energy dissipation approaches the limiting value of energy division consistent with Heisenberg's theory. (auth)

18608 INVESTIGATION OF THE INTERACTION OF $3.10^{11}-6.10^{12}$ ev NUCLEONS AT ALTITUDES OF 6-12 km. B. V. Tolkachev (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 46: 43-9(Jan. 1964). (In Russian)

The spectra of nucleons at altitudes of 12, 9, and 6.4 km are obtained in the energy range between 3×10^{11} and 6×10^{12} ev. The mean free path in air for nucleon absorption at the indicated energies is determined. The mean fraction of energy retained by the nucleon after the interaction is estimated by comparing the absorption mean free path and the inelastic interaction range for nucleons in air. (auth)

18609 NUCLEAR-ACTIVE PARTICLES IN YOUNG ATMOSPHERIC SHOWERS. Kh. P. Babayan, N. G. Boyadzhyan, E. A. Mamidzhanyan, N. L. Grigorov, Ch. A. Tretyakova, and V. Ya. Shestoperov (Moscow State Univ. and Inst. of Physics, Erivan). Zh. Eksperim. i Teor. Fiz., 46: 110-22(Jan. 1964). (In Russian)

The total energy of nuclear particles, E_n, in young atmospheric showers (y. a. s.) in which the energy of the electron-photon component $\geq 1.7 \times 10^{12}$ ev is measured. On the average the energy of the nuclear particles $E_n \leq (33 \pm 6)\%$, the nucleon energy E comprising $(17 \pm 3)\%$ of the energy of the particle producing the young atmospheric shower. It is shown that y. a. s. are produced in interactions with a mean inelasticity coefficient $\overline{K} \geq 0.83 \pm 0.03$ and a mean fraction of energy imparted to π^0-mesons in the interactions $\overline{K}_{\pi^0} \geq 0.67 \pm 0.96$. The probability for such interactions, W, is estimated. It is shown that almost 50% of all the energy imparted to the π^0-mesons is lost by the nuclear particles in processes with $\overline{K}_{\pi^0} \simeq 0.7$. (auth)

18610 OBSERVATION OF GALACTIC AND SOLAR COSMIC RAYS WITH EXPLORER 7. Wei Ching Lin and James A. Van Allen (State Univ. of Iowa, Iowa City). p.299-315 of "Astronautical Engineering and Science." New York, McGraw-Hill Book Co., Inc., 1963.

A summary of cosmic-ray intensity observations at high latitudes over North America and Australia at 550 to 1,100 km during the period Oct. 13, 1959, to Feb. 17, 1961, is presented. Data for 20 solar cosmic-ray events are included. The instrumentation is described. (R.E.U.)

18611 A PROBE FOR THE INTERPLANETARY PLASMA. K. W. Ogilvie (NASA-Goddard Space Flight Center, Greenbelt, Md.), N. McIlwraith, H. J. Zwally, and T. D. Wilkerson. p.91-6 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

The energy distributions of protons and other species of ions in interplanetary space as well as at satellite altitudes are studied using a new detection technique. Observations are made as a function of time, direction, and position over an energy range of 10 ev to 10 kev, with a maximum sensitivity of 10^{-18} amp, and the capability to detect single ions. Previous studies of the solar wind suggest many important measurements of its state, its interactions with planets, and its wave phenomena. The present instrument, which is $10 \times 30 \times 20$ (cm^3) in size, contains an electrostatic energy analyzer, a secondary-electron-scintillation detector, high voltage supplies, and signal conditioning circuits. Laboratory work demonstrates constant response for protons having energies from 30 ev to 3 kev and a minimum detectable current corresponding to about ten particles per second. Progress is reported on the development of a velocity selector for separating ionic species, hopefully leading to the solution of an important problem in solar wind studies: the determination of the relative abundance of protons and alpha particles. (auth)

Criticality Studies

18612 (ORNL-TM-821) THE EFFECT OF VARIOUS EXTERNAL NEUTRON ABSORBERS AND REFLECTORS ON THE REACTIVITY OF SOLUTIONS OF ^{239}Pu–^{240}Pu IN SLABS. J. P. Nichols (Oak Ridge National Lab., Tenn.). Mar. 31, 1964. Contract W-7405-eng-26. 4p.

Multi-group transport theory calculations were made to estimate the effect of various external neutron absorbers and reflectors on the reactivity of slabs containing solutions of ^{239}Pu–^{240}Pu. The results indicate that $\frac{1}{8}$ to $\frac{1}{4}$-in. boral is a more effective absorber than 0.02-in. cadmium and that water and paraffin are significantly better than concrete for isolation of subcritical units. (auth)

18613 CRITICAL PARAMETERS OF AQUEOUS URANYL NITRATE SOLUTIONS. V. G. Dubovskii, A. V. Kamaev, F. M. Kuznetsov, G. M. Vladykov, G. A. Popov, and Yu. D. Palamarchuk. At. Energ. (USSR), 16: 21-5(Jan. 1964). (In Russian)

The critical volumes of aqueous solutions of $UO_2(NO_3)_2$ solutions containing 90% enriched ^{235}U were determined on arrays containing spheres, cylinders, and rectangular parallelepipeds, assembled with and without water reflectors.

The walls were made of 1 to 1.5 and 3-mm thick stainless steel sheets; the U concentration of the solution was varied from 36 to 460 g/l, corresponding to a variation of the ratio of the H to the U nuclei, ρ_H/ρ_{U-235}, from 780 to 50. The experiments without reflector were carried out in cells, the concrete walls of which were at least 2 m from the assembly. The thickness of the reflecting water layer was at least 20 cm. No corrections were made for the temperature of the solution which varied from 15 to 21°C. An excess of 13.6 g of HNO_3 was added for each 100 g of U per liter of solution. By transforming the geometric parameters, the dimensions of the system consisting of a sphere, cylinder, and an infinite flat slab were obtained. For the aqueous $UO_2(NO_3)_2$ solution the following critical parameters were obtained: critical volume, 8.4 liter; critical mass, 0.85 kg of ^{235}U; diameter of the infinite cylinder, 16.7 cm; and thickness of the infinite slab, 6.9 cm. (TTT)

Direct Energy Conversion

18614 (AD-428194) LONG LIFE CLOSED LOOP MHD RESEARCH AND DEVELOPMENT UNIT. Interim Scientific Report No. 7, September 15, 1963–December 15, 1963. (Westinghouse Electric Corp., Pittsburgh). Dec. 31, 1963. Contract AF33(657)-8311. 33p.

The experience gained from a test with the closed-loop MHD research unit is the basis for design modifications, which will be made before the next test of the complete machine. Features of the control panel layout and function are discussed, and additional calculations predicting loop performance are presented. A metallographic examination of an expendable portion of the tantalum structure was made after the full-scale test. The material shows no evidence of deterioration which can be attributed entirely to the dissolution of impurities from the working fluid. The design of the closed loop modified with ceramic-lined end returns is presented as a replacement for the existing structure when the tantalum ultimately fails. (auth)

18615 (ANL-6725(p.224-42)) ENERGY CONVERSION. (Argonne National Lab., Ill.).

Temperature-emf-composition data for the lithium–bismuth cell were obtained over the temperature range from 750 to 1150°K. Similar data for the lithium–tin system are being determined. The lithium–tin cell delivers lower voltages than does a lithium–bismuth cell; however, since the tin vapor pressure is lower than that of bismuth, separation of the metals by vaporization at high temperature would be easier. The anomalous double exothermic break above the eutectic halt in the cooling curve of binary mixtures of liquid lithium hydride and lithium chloride was explained. Resolution of this anomaly shifted the lithium chloride solid-liquid equilibrium temperatures to lower values in the phase diagram. Values for excess chemical potentials and activity coefficients, which were calculated, indicated that the system is close to an ideal solution. The solubility of liquid lithium metal in liquid lithium chloride was 1.3 at. % at 610°C as determined by an isopiestic equilibration. This may be compared with a literature value of 0.5 ± 0.2 at. % at 650°C. Work on a transpiration apparatus for the study of liquid-gas phase equilibria is complete. A 100-g batch of relatively highly pure uranium monosulfide was prepared for use in thermoelectric parameter measurements and for measuring the heat of formation of uranium monosulfide. The Seebeck coefficient was measured as a function of temperature for two specimens of uranium monosulfide (a sintered pellet containing negligible insolubles and a slab fabricated from a melted ingot containing one percent insolubles). The coefficients for both samples showed a temperature dependence. The magnitude of the Seebeck coefficient values were similar to those previously reported for other uranium monosulfide specimens. The presence of higher sulfides such as U_2S_3 and U_3S_5 in uranium monosulfide resulted in a decrease in Seebeck coefficient values with increasing temperature; a change in the sign of the Seebeck coefficient occurred at approximately 600°C. A linear increase in resistivity with increasing temperature was found for a thorium monosulfide specimen. For a 50-50 mol % US–ThS solid solution, the resistivity was found to be virtually constant with temperature. The Seebeck coefficient as a function of temperature was also measured for a sintered specimen of uranium monophosphide. A temperature dependency was shown. The magnitude of the Seebeck coefficient values was similar to those obtained with uranium monosulfide. (auth)

18616 (ASD-TDR-63-700) LIQUID-METAL MAGNETOHYDRODYNAMIC POWER CONVERSION. Gene B. Stafford (Aeronautical Systems Div., Wright-Patterson AFB, Ohio). Sept. 1963. 28p. (CONF-445-1)

From Aeronautical Systems Division 1963 Science and Engineering Symposium, Wright-Patterson AFB, Ohio, Sept. 1963.

The basic operating characteristics of a straight channel, conduction, liquid-metal (MHD) generator are presented. The ideal case is treated, and the various losses that might occur are then introduced, along with means of compensating for them. Two systems are shown which can utilize a liquid-metal MHD generator. Criteria for the selection of the working fluids are shown, and possible working fluids are discussed. (auth)

18617 (CONF-414-1) DC AND HIGH-FREQUENCY VOLTAGE AND POWER OUTPUT AND INTERACTION IN CESIUM, POTASSIUM AND SODIUM THERMIONIC CONVERTERS. Hans Kohn Richards (Argonne National Lab., Ill.). [1963]. Contract W-31-109-eng-38. 40p. (CONF-458-1)

From Conference on Direct Energy Conversion, Argonne, Ill., Nov. 1963 and 3rd Annual Symposium on High Temperature Conversion Heat to Electricity, Tucson, Ariz., Feb. 1964.

A plasma diode with a Ta emitter and Mo collector and guardring was operated with Cs, K, and Na vapors. The emitter-collector-distance, vapor pressure, and emitter temperature were varied during the experiments. An inductance-capacitance network separated the d-c output from the high frequency r-f component and permitted study of interaction between d-c and r-f voltage, current and power output. The Cs and K cells performed quite similarly. The r-f frequencies were functions of the voltage applied at the collector against the grounded emitter and decreased with decreasing applied voltage. The ratio of the r-f to d-c power output started at an ion-rich plasma, increased with increasing electron density, reached a maximum and decreased again for a very electron-rich plasma. It appears that the ratio is somewhat higher for K than for Cs. Pulses of the r-f voltage exceeded frequently the ionization voltage of the alkaline vapor. The Na cell did not operate very well at pressures $<10^{-3}$ mm Hg., as could be expected since its ionization voltage exceeds the work function of the Ta emitter and contact ionization should be <1% of Cs ionization. At higher pressures, power densities of several watts were measured. The voltage output at the knee of the characteristic

was 0.3 to 0.4 volt < for Cs and K, due to the higher Na work function on the collector. (auth)

18618 (LADC-6239) EXPERIMENTAL OBSERVATIONS WITH A CESIUM PLASMA CELL WHICH HAS A URANIUM CARBIDE EMITTER. Walter H. Reichelt (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 29p. (CONF-458-1)

From the 3rd Annual Symposium on High Temperature Conversion Heat to Electricity, Tucson, Ariz., Feb. 1964.

The performance of a cesium plasma, planar diode with a UC emitter surface was investigated. The effects of Cs pressure and emitter temperature on the operating characteristics and power density were determined, and the electron temperatures and ion densities across the interelectrode gap were obtained by analysis (described) of spectroscopic measurements. (D.C.W.)

18619 (N63-14234) A REALISTIC APPROXIMATION TO THE EFFICIENCY OF THERMIONIC POWER GENERATORS. Scientific Paper 12-1401-1-P2. A. E. Fein and L. S. Richardson (Westinghouse Electric Corp. Research Labs., Pittsburgh). Dec. 20, 1960. 40p.

A simple model was constructed to permit the calculation of the operating characteristics of a thermionic diode. It was assumed that space charge was eliminated by a partially ionized plasma, the sole effect of which on the diode is to introduce an internal electrical resistance and thermal conductance. The efficiency of conversion of diodes of fixed parameters was then optimized with respect to lead resistance and operating voltage. Account was taken of back current and of the voltage drop, thermal conduction, and Joule heating of the leads and plasma. A criterion for the lifetime of a thermionic converter was developed, based upon the evaporation rate of the cathode. From this criterion, a relation between the heat of vaporization of the cathode and the maximum temperature at which it can be operated was derived. From the latter quantity, a means of calculating the ultimate efficiency attainable with a given cathode material was obtained. (auth)

18620 (NP-13768) DETAILED THEORETICAL AND EXPERIMENTAL STUDY ON A LARGE MHD GENERATOR. Research Report 174. J. F. Louis, G. Gal, and P. R. Blackburn (Avco Corp. Avco-Everett Research Lab., Everett, Mass.). Mar. 1964. 24p.

The performance of an MHD generator with a channel area ratio (outlet-to-inlet) of 2.5 was investigated experimentally over a wide range of mass flows, pressure ratios, Hall coefficients, and electrode geometries. The results showed that performance is improved by establishing a moderately supersonic flow in the generator. Also, for supersonic flows of interest ($M \leq 1.5$) the pressure loss due to a shock in off-design conditions is only slightly detrimental to performance. Analysis showed that a quasi-one-dimensional theory describes the flow quite accurately over a range of flows and electrode geometries. The theory can be used to predict the performance of MHD generators at design and off-design conditions. It was also found that the electrode losses associated with the presence of a Hall field can seriously hamper the performance of an MHD generator. (D.C.W.)

18621 (ORNL-3576) HANDBOOK OF SHIELDING REQUIREMENTS AND RADIATION CHARACTERISTICS OF ISOTOPIC POWER SOURCES FOR TERRESTRIAL, MARINE, AND SPACE APPLICATIONS. E. D. Arnold (Oak Ridge National Lab., Tenn.). Apr. 1964. Contract W-7405-eng-26. 221p.

The radiation intensities from shielded and unshielded sources fabricated from seventeen isotopes that show promise for use in isotopic power or radiation applications were calculated. Source sizes in the range of 100 to 20,000 thermal watts were evaluated. All shielded sources were assumed to be attenuated by Fe, Pb, and U; and in those cases where the source also emitted neutrons, neutron and gamma attenuation through water was determined. The isotopes studied and their physical form are as follows: ^{60}Co (metal), ^{85}Kr (liquefied gas), ^{90}Sr (oxide and titanate), Zr-^{95}Nb (oxide), ^{106}Ru (metal), ^{137}Cs (glass), ^{144}Ce (oxide), ^{147}Pm (oxide), ^{170}Tm and ^{171}Tm (both as oxides), ^{204}Tl (metal), ^{210}Po (metal matrix with void space for gas collection), ^{232}U (oxide), ^{228}Th (oxide matrix with void space for gas collection), ^{238}Pu (oxide), ^{242}Cm (oxide matrix with void space for gas collection), and ^{244}Cm (oxide). The use of the graphical results to calculate separation distance, shield thickness, and shield weight is demonstrated. (auth)

18622 (PWA-2170) INVESTIGATION OF MAGNETOHYDRODYNAMIC POWER GENERATION. VOLUME I. SYSTEM ANALYSIS AND ENVIRONMENTAL TESTING. Final Report. (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). May 1963. Contract AF30(602)-2487. 319p. (AD-416721; RADC-TDR-62-464(Vol.I)

A system analysis was performed to establish the design and performance characteristics of 250- and 1000-Mev MHD generators. The results are presented, and the necessary equations are derived. The results of environmental tests that investigated boundary and bulk conductivity, structural concepts, and combustion phenomena are included. The other five volumes of the report are summarized, together with the principal conclusions. (D.C.W.)

18623 ON THE ELECTRICAL CONDUCTIVITY OF SEEDED AIR COMBUSTION PRODUCTS. D. V. Freck (Central Electricity Research Labs., Leatherhead, Surrey, Eng.). Brit. J. Appl. Phys., 15: 301-10(Mar. 1964).

Calculations are made of the electron density, electron mobility, and electrical conductivity of air combustion products, seeded with potassium, over a range of temperatures, pressures, mixture ratios, fuels and degrees of seeding likely to be of interest in magnetohydrodynamic power generation. The results are presented in the form of a number of graphs. The electrical conductivity is found to be very sensitive to changes in mixture ratio at the lower temperatures. A total variation of as much as 2 to 1 in conductivity could be introduced by a 4% change in the amount of air used for combustion, although this effect is not so pronounced at higher temperatures. The maximum gas conductivity is likely to occur when there is an excess of fuel. (auth)

18624 A LASER EXCITED BY NUCLEAR HEAT. Fred M. Johnson (Electrical-Optical Systems, Inc., Pasadena, Calif.). Nucleonics, 22: No. 4, 57-60(Apr. 1964).

In the proposed system heat from nuclear fuel is transferred to a cathode causing electrons to be thermally emitted into a gas diode operated in the arc-mode regime. The gas cell is so constructed as to constitute the laser itself. In this manner it should be possible to convert nuclear energy directly into coherent radiation in a single unit. (C.E.S.)

18625 LOW-FREQUENCY CURRENT OSCILLATIONS IN PLASMA THERMIONIC CELLS. V. Ya. Karakhanov and D. G. Tatishvilli (Khar'kov State Univ.). Radiotekhn. i Elektron., 9: 138-43(Jan. 1964). (In Russian)

Low-frequency current oscillations in plasma thermoelements were investigated at low cathode temperatures. Oscillation development and frequencies were analyzed as

functions of cathode temperature, cesium vapor pressure, and interelectrode distances. (tr-auth)

18626 VOLUME IONIZATION IN A THERMIONIC CONVERTER GAS. J. Bensimon (CSF, Corbeville, France). p.513-19 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In French)

In gas-filled converters, the electron space charge can be neutralized by the introduction of positive ions. Most often a gas with a relatively low ionization potential is used for this purpose. The ionization of the gas seems, in the case of thermodynamic equilibrium, to be ruled by macroscopic laws. Volume microscopic effects cancel out, and only surface microscopic effects need be taken into account. If, however, thermodynamic equilibrium is destroyed, microscopic volume phenomena become important and must be taken into account. Surface effects are assumed to be negligible for purposes of this investigation. Only volume phenomena, which are favorable to the formation of ions and which can be described in terms of local equilibrium, are considered. The study is divided into two parts: one- and two-step ionization by electrons; and two-step ionization by photons and electrons. (tr-auth)

18627 INVESTIGATIONS ON THE LOW VOLTAGE ARC MODE IN THERMIONIC DIODES. W. Bloss and W. Krezdorn (Technische Hochschule, Stuttgart). p.521-6 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

In rare gas-filled thermionic diodes, the existence of the low-voltage arc was observed in defined ranges of collector current and in the medium pressure range. The low-voltage arc is characterized by a bright plasma ball and a region of current-carrying dark plasma. With an axial magnetic field, a uniform rotation of the plasma ball is initiated that permits the measurement of plasma parameters in the ball and in the dark plasma region. With single and double probes the electron temperature, carrier density, and plasma potential were measured. The experimental results are discussed. (auth)

18628 A WORK FUNCTION STUDY OF THE EVAPORATION FROM URANIUM CARBIDE. B. H. Blott and B. J. Hopkins (Univ. of Southampton, Eng.). p.533-6 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

A retarding potential technique was applied to study the evaporation from electrophoretically deposited uranium carbide on a tantalum carbide substrate. Curves were obtained showing the change with time of the work function of a tungsten strip anode as evaporation took place from the cathode at various temperatures. From such data it is possible to derive the activation energy for the evaporation process and also the minimum work function reached by the anode. Cathodes that were outgassed for long periods at temperatures exceeding 2100°K showed different evaporation characteristics from those that had not received such extreme treatment. It is concluded that there are at least two distinct evaporants from electrophoretically deposited uranium carbide; a component that is relatively easily evaporated and produces a minimum anode work function of about 3 ev, probably an oxide of uranium, and a material with a much lower evaporation rate producing a minimum anode work function of 3.5 ev. (auth)

18629 ANALYSIS OF THE I-V CURVE OF A HIGH-PRESSURE Cs DIODE. J. Bohdansky and R. Langpape (Brown, Boveri, and Cie AG, Mannheim, Ger.). p.543-5 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

Under certain conditions the I-V curve of a Cs diode shows a saturation region for the current in the extinguished mode. It can be proved that the magnitude of this maturation-current is determined not only by the space-charge-sheathes at the electrodes but also by the ratio of mean free path of electrons in the plasma to the electrode spacing A rather simple relation exists when a negative space-charge is created at the cathode. This relation enables the collision cross section of Cs-atoms for electrons in the plasma to be determined by the I-V curve. The calculated values of the saturation-current correspond very well to the measured values of Houston and Gibbons. (auth)

18630 ON A PROCESS OF CONVERSION INTO ELECTRIC ENERGY OF IONIZATION LOSS IN A NUCLEAR REACTOR. Siegfried Klein (Centre d'Etudes Nucleaires, Saclay, France). p.537-41 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In French)

Previous experiments have shown that it is possible to obtain an electromotive force of the order of few volts when two metallic electrodes are inserted in an ionized vapor such as mercury, cesium, or water, and that the ionizing agent can be a soft x-ray source. An experiment in the nuclear reactor EL 3 is described, where the ionizing agents are the fission products of a uranium oxide surface. Ionized water vapor was used. The experiment shows that it is also possible to obtain an electromotive force when the fission products act as ionization agents. The obtained electromotive force was in the order of 1 volt and the measured electrical current was close to the maximum theoretical value. (auth)

18631 THERMOELECTRICITY. Courtland M. Henderson and Darrel M. Harris (to Monsanto Chemical Co.). U. S. Patent 3,127,287. Mar. 31, 1964. Filed June 9, 1961.

A thermoelectric device is described which is capable of generating power at temperatures up to 1950°C. The device comprises a first element of boron in combination with 0.05 to 40% Ti, and a second element of at least one of the class C, Cu, Au, Ag, Ni, Co, Fe, Re, V, Hf, Nb, Si, Ta, Be, and compounds of these elements. Various substances may also be added to the B–Ti composition in the first element. (D.L.C.)

18632 MAGNETOHYDRODYNAMIC GENERATOR. Edmund C. Lary and Russell G. Meyerand, Jr. (to United Aircraft Corp.). U. S. Patent 3,127,528. Mar. 31, 1964. Filed Oct. 3, 1960.

A magnetohydrodynamic generator is designed to generate alternating current without the use of electrodes. In the generator, a high-temperature ionized gas stream is moved through a duct at supersonic velocity and subjected to electromagnetic oscillations of a specific frequency to produce a series of bunched, conductive particles. The bunches are then subjected to a second electromagnetic oscillation of the same frequency to extract electrical a-c energy. A part of the extracted electrical energy is bootstrapped to produce the first oscillations. Several embodiments of the generator are described, including a closed cycle system and an open-cycle system for a rocket. (D.L.C.)

Elementary Particles and Radiations

Refer also to abstract 18745.

18633 (AFOSR-3501) SCATTERING FOR THE K^{-}-MESON FROM THE DEUTERON. Technical Report No.

265. Anand Kumar Bhatia (Maryland. Univ., College Park). Aug. 1962. Contract AF49(638)-24. 94p. (AD-414423)

A simple model for the scattering of mesons(K^-) by deuterons is constructed. The nucleon is not treated as heavy; and the multiple scattering, the binding energy corrections, and the contribution from the off-energy shell scattering are taken into account. The model is compared with the Brueckner model and with experimental data on K^--d cross sections. (D.C.W.)

18634 (CONF-452-1) EVIDENCE FOR TWO NEW RESONANCES IN THE π-NUCLEON SYSTEM. PART II. R. Alvarez, Z. Bar-Yam, W. Kern, D. Luckey, L. S. Osborne, S. Tazzari (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science); and R. Fessel (Cambridge Electron Accelerator, Mass.). [Mar. 30, 1964]. Contract AT(30-1)-2098. 12p.

From American Physical Society, Washington, D. C., Apr. 1964.

Structure in the cross sections for meson(π) photoproduction suggest resonances at energies of 2.9 and 3.5 Bev with probable assignments of $T = 3/2$ and $1/2$, respectively. Gamma-proton coincidence analysis indicates a mass of 490 ± 80 Mev for the particles produced with the protons. A possible explanation is presented, and the parity and spin assignments are considered. (D.C.W.)

18635 (DESY-64/1) PHOTOPRODUCTION OF ρ- AND ω MESONS IN THE PERIPHERAL MODEL. H. Joos (Deutsches Elektronen-Synchrotron, Hamburg); and G. Kramer (Germany. Physikalisches Staatsinstitut, Hamburg). Feb. 1964. 16p.

The photoproduction of mesons(ρ) and (ω) on nucleons is calculated. The possible matrix elements in the peripheral model are constructed, and the cross section is obtained. π, η, δ(ABC), and vector meson exchanges is taken into account. The angular distribution of the decay pions from the polarized mesons(ρ) is derived on the basis of peripheral production. (auth)

18636 (JINR-D-1551) NEGATIVE MUON CATALYSIS OF THE NUCLEAR FUSION REACTION $d + d \rightarrow He^3 + n$. V. P. Dzhelepov, V. V. Filchenkov, M. Friml, Yu. V. Katyshev, V. I. Moskalev, and P. F. Yermolov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 7p.

Twenty occurrences of the previously unobserved reaction $d\mu + d \rightarrow (dd\mu)^+ \rightarrow He^3 + n + \mu^-$(2) were detected in a diffusion cloud chamber filled with deuterium up to 7.2 atm. The branching ratio (2) over $(dd\mu)^+ \rightarrow t + p + \mu^-$(1) is 1.20 ± 0.37. The estimates of the relative yields of the reactions $(dd\mu)^+ \rightarrow \rho\mu + t$(3) and $(dd\mu)^+ \rightarrow (He^3\mu)^+ + n$(4) indicate that $w(3)/w(1) < 0.13$ and $w(4)/w(2) < 0.13$ with a probability of 90%. The yield for (1) agrees with previous results, but the yields of 1 and 2 are an order higher than those expected on the basis of data for (1) in liquid deuterium. (auth)

18637 (JINR-E-1512) FERMI INTERACTIONS AT HIGH ENERGIES. G. Domokos, P. Suranyi, and A. Vancura (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 21p.

The four lepton vertex function is investigated in the ladder approximation. The vertex function of lepton-lepton scattering amplitude is determined uniquely; arbitrary renormalization constants do not appear in the final expressions. The partial wave amplitude is a meromorphic function of the four-dimensional angular momentum in the whole complex plane. The Fermi coupling constant is renormalized by the finite factor $(2/\pi)^{1/2}$. The scattering amplitude is purely imaginary at high energies. The correction factor to the angular distribution is a universal function of the variable $x = -\log s\,[\log(-t)]^{-1}$. The differential cross section decreases with energy as $s^{-1}(\log s)^{-2}$, and the elastic cross section decreases as $s^{-1}\log s$. The half-width of the forward peak is constant. The contribution of the direct channel to the cross section decreases as $s^{-1/2}$. (auth)

18638 (JINR-E-1550) HIGHER SYMMETRIES OF STRONG INTERACTIONS AND ASYMPTOTIC RELATIONS BETWEEN MESON-BARYON SCATTERING CROSS SECTIONS. A. A. Logunov, Nguyen Van-hieu, and Ting-chang Hsien (Joint Inst. of Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 20p.

Relations between the amplitudes of meson-baryon scattering processes in the triplet and octet models of unitary symmetry and in the model with symmetry group G_2 are used to derive asymptotic relations between the scattering cross sections in these models. (D.C.W.)

18639 (JINR-P-1524) NEUPRUCIE PERIFERICHESKIE STOLKNOVENIYA PRI SVERKHVYSOKIKH ENERGIYAKH. (Peripheral Inelastic Interactions of Very High Energies). P. Smrzh (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 8p.

It is shown that in terms of the multiperipheral model, constancy of the cross-sections leads to constant inelasticity and transverse momentum of the recoil nucleon. From the asymptotic values of the total cross-sections $\sigma_{NN} = 40$ mb and $\sigma_{\pi N} = 22.5$ mb, $\overline{K} = 0.36$ and $\overline{P} = 0.47$ Bev/c are obtained in the asymptotic region. A model for inelastic N–N interactions at high, but finite, energy is suggested, which describes the creation of the two fire-balls and contains no free parameters, except σ_{NN} and $\sigma_{\pi N}$. (auth)

18640 (JINR-P-1525) ASIMPTOTIKA AMPLITUDY RASSEYANIYA DLYA KOMPTON-EFFEKTA. (The Asymptotic Behaviour of the Compton Scattering Amplitude). N. I. Usyukina (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 8p.

The asymptotic behavior of the Compton scattering amplitude at $t \rightarrow \infty$ is obtained by summing a certain class of the perturbation theory diagrams with the help of renormalization group. The calculations were carried out in the threshold region $S \rightarrow 4m^2$. (auth)

18641 (JINR-P-1529) IZUCHENIE GENERATSII Σ^0-GIPERONOV V KSENONOVOI PUZYR'KOVOI KAMERE, OBLUCHENNOI π^--MEZONAMI S IMPULSOM 9 Bev/c. (A Study of Σ^0 Hyperon Generation in a Xenon Bubble Chamber Exposed to 9 Gev/c π^--Mesons). T. Kanarek and A. Filipkovski (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1964. 7p.

An attempt was made to identify hyperons(Σ^0) produced in the interaction of 9-Bev/c mesons(π^-) in a xenon bubble chamber. The V^0 events which were accompanied by the conversion of gamma quanta of moderate energies were selected. The distribution of the effective masses of the system (Λ^0-γ) has a washed out peak in the range of the hyperon(Σ^0) mass; the Monte-Carlo method gives similar distributions of the effective masses of the system (Λ^0-γ) making it impossible to identify hyperons(Σ^0). (auth)

18642 (JINR-P-1533) OB ANALITICHESKIKH SVOISTVAKH AMPLITUDY PION-PIONNOGO RASSEYANIYA V PLOSKOSTI UGLOVOGO MOMENTA. (On the Analytical Properties of the Pion-Pion Scattering Amplitude in the Angular Momentum Plane). Ya. Kvetsinskii

and P. Shuranii (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 9p.

The solution of the Bethe-Salpeter equation with an iterated bubble exchange kernel is investigated. It is shown that the leading singularity in the complex l lane is a pole. The behavior of the pole in s for small values of the coupling constant is found. The solution has a singularity in the coupling constant. The experimental consequences of the results are considered. (auth)

18643 (JINR-P-1560) O DVUKHFOTONNOI DIAGRAMME V RASSEYANII ELEKTRONOV NA PROTONAKH. (On Two-Photon Diagram in Electron Scattering on Protons). Edvard Kaputsik (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 5p.

It is shown that no unambiguous conclusions on the magnitude of the two-photon diagram contribution can be drawn from the linear dependence on $\tan^2 \theta/2$ of the cross section for electron scattering on protons. (auth)

18644 (NP-13695) KOGERENTNYE EFFEKTY PRI TORMOZNOM IZLUCHENII UL'TRA-RELYATIVISTSKIKH ELEKTRONOV. (Coherent Effects of Bremsstrahlung Ultra-relativistic Electrons). V. M. Galitskii and I. I. Gurevich (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). 1963. 18p.

Classical coherence conditions were used in studies of bremsstrahlung from ultrarelativistic electrons in dense media. General expressions developed for bremsstrahlung attenuation in a medium were used for developing the Landau-Pomeranchuk effect (multiple scattering) and Ter-Mikaelyan effect (polarization of the medium). Bremsstrahlung angular distribution in the medium was analyzed. It is shown that with sufficiently high electron energies the bremsstrahlung is attenuated by quantum absorption, in addition to polarization and multiple scattering. The spectral distribution in a frequency region where absorption is the main effect was found. (tr-auth)

18645 (NP-13782) ISSLEDOVANIE REAKTSII $\pi^- + p \rightarrow p + \pi^- + \pi^+ + \pi^-$ PRI ENERGII 2.8 Bev. (Investigation of Reactions $\pi^- + p \rightarrow p + \pi^- + \pi^+ + \pi^-$ at 2.8 Bev). V. K. Grigorev, A. P. Grishin, V. V. Vladimirskii, K. A. Trostina, I. A. Erofeev, and G. D. Tikhomirov (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki and U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 12p.

The effective mass distribution for the three pions in the interaction $\pi^- - p \rightarrow p - \pi^- - \pi^+ - \pi^-$ was measured. Irregularities in the mass region 0.9 to 1.0 Bev/c indicate the possible existence of three-pion resonances with T = 1 or 2. (auth)

18646 (NP-13783) O SFORMIROVANII PUCHKA μ-MEZONOV BOLSHOI ENERGII. (Formation of High-Energy Muon Beams). N. A. Burgov and A. G. Beda (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eskperimental'noi Fiziki and U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 14p.

The production of muon beams using an iron-free magnetic system consisting of parallel, high-current wires was considered. The equations of particle motion in the system were derived, and the efficiency of the system was evaluated by the Monte Carlo method. The system was found to retain most of the muons produced in pion decays. Tests proved the correctness of the assumptions made and confirmed the feasibility of the arrangement. (auth)

18647 (TID-20378(Sect.1)) COMPUTATION OF PHASE SHIFTS, SCATTERING LENGTH, AND EFFECTIVE RANGE FOR CENTRAL POTENTIALS. F. Coester (Argonne National Lab., Ill.); and Edward Yen (Iowa. State Univ., Iowa City). 45p.

Four FORTRAN programs were developed to compute phase shifts, scattering length, and the effective range for central potentials. The integration formulas used with the differential equations and the associated errors are discussed. One program evaluates errors in the integration; a second tests the integration formula by computing the regular Coulomb wave function. The relations and techniques used to compute the scattering parameters and p-p phase shifts are outlined, and the listings for all four programs are included. (D.C.W.)

18648 (UCRL-7155-T) ZERO ENERGY PARAMETERS FOR ATTRACTIVE AND REPULSIVE GAUSSIAN, EXPONENTIAL, YUKAWA AND HARD-CORE YUKAWA POTENTIALS. Richard D. Levee and Robert L. Pexton (California. Univ., Livermore. Lawrence Radiation Lab.). Dec. 1962. Contract W-7405-eng-48. 17p.

Effective ranges and scattering lengths were calculated for Gaussian, exponential, and Yukawa potentials for values of the strength parameter s between −4 and +2 and for hard core Yukawa potentials for values of s between −0 and +2. The results are tabulated and can be used for any system with no or one bound state and no internal degrees of freedom. (D.C.W.)

18649 (UCRL-11180) PION-PROTON ELASTIC SCATTERING IN THE ENERGY RANGE 300 TO 700 Mev (thesis). Philip M. Ogden (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 20, 1964. Contract W-7405-eng-48. 95p.

Differential cross sections for elastic π-p scattering were measured at eight energies for positive pions and seven energies for negative pions. Energies ranged from 310 to 650 Mev. Fifty-one scintillation counters and a matrix-coincidence system were used to measure simultaneously elastic events at 21 angles and charged inelastic events at 78 π-p angle pairs. Events were detected by a coincidence of pulses indicating the presence of an incident pion, scattered pion, and recoil proton and the results were stored in the memory of a pulse-height analyzer. Various corrections were applied to the data and a least-squares fit was made to the results at each energy. The form of the fitting function was a power series in the cosine of the center-of-mass angle of the scattered pion. Integration under the fitted curves gave values for the total elastic cross section. The importance of certain angular-momentum states, particularly the D_{13} state near 600 Mev, is discussed. Several possible explanations are given of the enhancement in the π^--p cross sections near 600 Mev. (auth)

18650 (UCRL-11150) A MEASUREMENT OF THE FORWARD DIFFERENTIAL CROSS SECTION FOR π^--p ELASTIC CHARGE-EXCHANGE SCATTERING AT 1.03 Bev/c USING THE 72-INCH HYDROGEN BUBBLE CHAMBER AS A NEUTRON DETECTOR (thesis). Alan Natapoff (California. Univ., Berkeley. Lawrence Radiation Lab.). Dec. 1963. Contract W-7405-eng-48. 117p.

The forward differential cross section for charge exchange (π^--p → π^0 + n) at 1.03 Bev/c was measured. The secondary neutrons were detected by visible stopping protons from subsequent elastic scatters n − p → n − p. The real events were separated from spurious events by a Boolean algebraic method. The residual background fraction was estimated to be 10%. About 5% of the secondary neutrons emitted in the charge exchange interaction were detected. There were 12 experimental events in three intervals lying in the range $0.84 \leq \cos \theta_{\pi^0}^{c.m.} \leq 0.96$. A zero-constraint, least-squares fit of the distribution

gave a cross section of 3.65 ± 1.93 mb/sr. This result is consistent with predictions based on π-N dispersion relations obtained from the principle of microcasuality and the optical theorem. (auth)

18651 COMPLETELY COHERENT RADIATION. William Streifer (Univ. of Rochester, N. Y.). Ann. Phys. (N. Y.), 27: 72-8(Mar. 1964).

Some aspects of the scalar coherence theory of radiation employing two-point correlation functions are considered. In particular, it is shown that "real" waveforms in polychromatic fields need not appear similar to be considered coherent under the present definition. The decomposition of the mutual coherence function for such fields is discussed. Under certain assumptions a general form for coherent fields is derived and these fields are shown to satisfy the equations of geometric optics. For homogeneous media the surfaces of constant phase are the so-called cyclides of Dupin. The significance of these results in relating coherent sources and fields is mentioned as is the decomposition of incoherent sources. (auth)

18652 NEUTRINO PHYSICS. G. Von Dardel. CERN Courier, 3: 29-33(Mar. 1964).

The role of the neutrino in explaining certain experimental results is discussed. It is shown how the neutrino is related to other fundamental particles, why it interacts so rarely, and how the existence of two kinds of neutrino was proved. Some implications for the future are discussed, including the problem of the so-called intermediate boson. (R.E.U.)

18653 A METHOD OF CALCULATING THE INTEGRAL ABSORPTION OF GAMMA RAYS IN A MACROSYSTEM. B. I. Vainshtein (Karpov Inst. of Physics and Chemistry, Moscow). Dokl. Akad. Nauk SSSR, 154: 411-14(Jan. 11, 1964). (In Russian)

A method is presented for calculating the integral absorption of γ rays by a large body of arbitrary shape on comparing the body with an equivalent sphere of radius R. The linear coefficients of attenuation and absorption (μ and μ_a) must be known for the material in question. The method is valid to within 5 percent for gamma energies of 0.7 to 5.0 Mev, and for $\mu R < 4$. The results of this method are in good agreement with those of a Monte Carlo calculation for E = 1.25 Mev. (TTT)

18654 SOME RATIONAL APPROXIMATIONS FOR THE K_{i_3} AND K_{i_4} FUNCTIONS. A. J. Clayton (United Kingdom Atomic Energy Authority, Winfrith, Dorset, Eng.). J. Nucl. Energy, Pt. A & B, 18: 82-4(Feb. 1964).

Rational approximations for the K_{i_3} and K_{i_4} functions that occur in the calculation of first-collision probabilities in cylindrical geometry are presented. (C.E.S.)

18655 REGGE POLES AND PERTURBATION THEORY. A. A. Logunov, Nguyen Van-Hieu, A. N. Tavkhelidze, and O. A. Khrustalev (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys., 49: 170-6(Nov. 1963).

The contributions of the cuts in the l-plane to the scattering amplitude are investigated. A way of separating the pole terms is discussed. These terms should be understood as the main ones in the expansion in powers of $e^2m(m^2 - E^2)^{-1/2}$. (auth)

18656 NUCLEON-NUCLEON SCATTERING WITH FULL RECOIL. II. THE ONE-AND-TWO-PION AND VECTOR BOSON CONTRIBUTIONS. E. Gotsman and S. Hochberg (Imperial Coll. of Science and Tech., London). Nucl. Phys., 49: 177-89(Nov. 1963).

The kernels corresponding to the exchange of a vector boson in nucleon-nucleon scattering are computed using the Tamm-Dancoff-Dyson (T.D.D.) formalism. These kernels are compared with those obtained using the Fukada-Sawada-Taketani (F.S.T.) method. The ρ-nucleon coupling constants are derived from form factor data, while the vector ω-nucleon coupling constant is treated as a parameter and determined so as to give agreement with the experimental $^3P_1$ phase shift at 137 Mev lab. Using the sum of the one-pion, two-pion, ρ and ω kernels, phase shifts are computed for uncoupled singlet and triplet states for $0 \leq l \leq 3$, and compared with other theoretical and experimental values. (auth)

18657 CROSSING RELATIONS FOR HELICITY SCATTERING AMPLITUDES. M. S. Marinov and V. I. Roginskii (Roginsky) (Inst. of Theoretical and Experimental Physics, Moscow). Nucl. Phys., 49: 251-6(Nov. 1963).

The rule for the channel-to-channel transition is formulated for an arbitrary amplitude describing the non-zero spin particle interaction. The matrix connecting the four-point amplitudes for the s and t channels referred to the respective center-of-mass frames is found for arbitrary masses and spins. (auth)

18658 LOW ENERGY PROTON-DEUTERON AND NEUTRON-DEUTERON SCATTERING. Kalman Kalikstein (New York Univ., New York and Naval Shipyard, Brooklyn), Leonard Rosenberg, and Larry Spruch. Nucl. Phys., 49: 257-78(Nov. 1963).

It is not known which of two sets of experimental values for n-d scattering lengths is correct. Previously it was shown that upper bounds on the scattering lengths could be obtained theoretically. These bounds would indicate that the first set of n-d scattering lengths is correct, except that an unrealistic assumption is made about the central potential. Here, an upper limit is obtained for zero-energy p-d scattering lengths. Central potentials are assumed, but an effective-range approach, avoiding dependence on the radial and exchange nature of the central potentials, is used. The experimental value for the p-d scattering length is very close to this upper bound. Thus the first set of n-d scattering lengths, similarly close to their theoretically obtained upper bounds, is indicated correct. Bounds are found for other parameters in low energy nucleon-deuteron scattering. (M.J.T.)

18659 GENERAL THEORY OF ANGULAR CORRELATIONS OF SUCCESSIVELY DECAYING PARTICLES. Yoshiaki Ueda and Susumu Okubo (Univ. of Rochester, N. Y.). Nucl. Phys., 49: 345-51(Nov. 1963). (NYO-10267)

A general theory of relativistic angular correlations of successively decaying particles is given on the basis of the helicity formulation. As examples, the decays of Ξ and Σ^0 are investigated in detail. (auth)

18660 COVARIANT DESCRIPTION OF THE PHOTODISINTEGRATION OF THE DEUTERON. P. J. O'Donnell (Glasgow Univ.). Nucl. Phys., 49: 475-80(Dec. 1963).

Recent attempts to apply dispersion relations to the photodisintegration of the deuteron are examined and the question of choice of Lorentz invariants is considered. A restrictive assumption in a previous treatment about the motion of the deuteron is removed and the more general expressions thus obtained are given. (auth)

18661 ON THE DETERMINATION OF QUANTUM NUMBERS OF K2π AND K3π RESONANCES. G. I. Kopylov (Joint Inst. for Nuclear Research, Dubna). Nucl. Phys., 49: 566-76(Dec. 1963).

Criteria are found to determine the spin and parity of possible resonances in K2π and K3π systems. (auth)

18662 ELEMENTARY PARTICLES AND GENERALIZED STATISTICS. I. Bialynicki-Birula (Univ. of Warsaw). Nucl. Phys., 49: 605-8(Dec. 1963).

The commutations relations of creation and annihilation operators proposed by Kamefuchi and Takahashi are derived in a simple, purely algebraic way from basic postulates. Creation and annihilation operators obeying these generalized commutation relations are explicitly constructed. It is argued that the operators describing elementary particles should obey standard commutation or anti-commutation relations. (auth)

18663 UNIFIED DESCRIPTION OF SPINORS AND MODEL OF ELEMENTARY PARTICLES. H. A. Sokolik (All-Union Research Inst. of Electromechanics, Moscow). Nucl. Phys., 50: 171-6(Jan. 1964).

It is shown that a model of elementary particles can be based on the possibility of reducing the basic elements of the representations of the extended Lorentz group to anomalous and normal spinors. (auth)

18664 FORBIDDEN CONFIGURATIONS IN MANY-MESON DECAYS. G. I. Kopylov and V. I. Ogievetskii (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys., 50: 241-66(Jan. 1964).

The most general dynamically independent symmetries of multi-pion systems with definite spin, parity, and isospin are considered. The forbidden pion configurations following from them, for systems of four and three pions in states with spin 0, 1, 2, isospin 0, 1, and parity ±1 are enumerated. This can be used to determine the quantum numbers of conceivable resonance systems decaying into pions via strong interactions. (auth)

18665 SINGULARITIES OF SOME FEYNMAN GRAPHS. Yi-cheng Liu and I. T. Todorov (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys., 50: 273-80(Jan. 1964).

Examples are considered of the application to some scattering graphs of the parametrical equations for the proper singularities of the Feynman graphs obtained earlier. (auth)

18666 AN APPROXIMATION METHOD FOR HIGH-ENERGY POTENTIAL SCATTERING. Yoshihiko Nishida, Masaaki Shimauchi, and Hiromi Tanaka (Saga Univ., Japan). Nucl. Phys., 50: 403-16(Jan. 1964).

The scattering of high-energy Schrödinger particles is investigated by a simple approximation method for some spherically symmetrical potentials which have no sharp boundaries but whose shapes do not deviate much from a square well form. The method is applicable when the strength of the potential is substantially smaller than the incident energy and k_0R is greater than unity, where k_0 is the wave number of the incident particle and R is a rough measure of the range of the potential. The procedure uses the Hart-Montroll internal wave function for the square well potential. Then the scattered amplitude can be written in a form similar to that of the second Born approximation. The method is applied to the scattering by Gaussian and harmonic well potentials which may be complex. The scattered amplitudes can be written in tractable forms, and it is expected that they can be used with good accuracy for a fairly wide range of scattering angles, including those around $(k_0R)^{-1}$, in contrast with the Schiff or Glauber approximation. Finally, numerical illustrations are given, and the results are compared with those of the exact method and other approximations. Thereby the validity and usefulness of the present method are confirmed. (auth)

18667 DYNAMICAL MODEL OF THE DEUTERON BASED ON THE THEORY OF REGGE POLES. Yu. M. Malyuta (Inst. of Physics, Kiev). Nucl. Phys., 50: 525-8 (Jan. 1964).

An approximation scheme, based on the unitarity condition and dispersion relations, is applied to the calculation of the deuteron Regge trajectory. (auth)

18668 A MEASUREMENT OF THE WOLFENSTEIN R′ PARAMETER IN p-p SCATTERING AT 140 Mev. O. N. Jarvis (Atomic Energy Research Establishment, Harwell, Berks, Eng.), B. Rose, G. H. Eaton, and C. P. Van Zyl. Nucl. Phys., 50: 529-48(Jan. 1964). (AERE-R-4398)

Measurements were made of the Wolfenstein R′ parameter at c.m. angles 31.4, 41.7, 52.0, 61.8, 72.1 and 82.2 degrees. The values obtained were +0.625 ± 0.062, +0.548 ± 0.062, +0.470 ± 0.069, +0.343 ± 0.058, +0.466 ± 0.095, and 0.190 ± 0.177, respectively. These values were deduced from asymmetry measurements which were proportional to the combination ($R \cos\theta_S + R' \sin\theta_S$) of the R and R′ parameters, where the spin precession angle θ_S was approximately 45°. Previous determinations of the R parameter permitted the above values for R′ to be obtained from the data. These measurements were found to be in good agreement with the predictions of phase-shift analyses at 140 Mev. (auth)

18669 RESUMMATION IN THE MANY-NUCLEON PROBLEM. J. E. Young (Los Alamos Scientific Lab., N. Mex.). Nucl. Phys., 51: 1-26(Feb. 1964). (LADC-5900)

A description of the many-fermion system is considered wherein the choice of trial function for the energy is composed of excited hole-particle states plus the usual Slater determinant of occupied Hartree-Fock (H-F) states. The principle is, then, to arrange the adiabatic perturbation expansion so as to reflect this choice. In particular, one studies how the configuration mixing affects the fermion self-energies and thereby the spectrum of states. Density-density correlations play an important role in the analysis. These are of the particle-hole type, and their existence leads to an expression for the self-energy that depends upon the two-body scattering operator t up through the 4th order in that quantity. This is in the ladder approximation. Particle-hole scatterings modify the usual t-matrix of Brueckner's theory. It is found that the 2nd and 3rd order rearrangement energies appear quite naturally in the theory. The second of these exhibits the renormalization of the Fermi sea, occupied H-F states, which is characteristic of the particle-particle graphs in a density-correlated system. It is concluded that all these effects are included in the first-order fermion self-energy expression obtained by Martin and Schwinger. (auth)

18670 NUCLEON CORE AND LOW ENERGY PHENOMENA. K. V. Laurikainen, R. M. K. Haemaelaeinen, and E. I. Peltola (Univ. of Helsinki). Nucl. Phys., 51: 33-40(Feb. 1964).

Finite core potentials of the square well type (soft cores) are investigated by applying the usual one-pion-exchange potential outside the core. It is shown that variation of the soft-core parameters can produce substantial changes in the properties of the deuteron, especially the D-state probability. In view of the resulting nuclear properties, the hard core does not appear to be a limiting case of a soft core. (auth)

18671 MEASUREMENT OF THE CROSS-SECTION FOR PROTON-PROTON SCATTERING AT 90° (c.m.) BETWEEN 20 AND 50 Mev. C. J. Batty (National Inst. for Research in Nuclear Science, Chilton, Berks, Eng.), G. H. Stafford, and R. S. Gilmore. Nucl. Phys., 51: 225-33(Feb. 1964).

The cross section for proton-proton scattering at an angle of 90° c.m. was measured at 7 energies between 20 and 50 Mev to an accuracy of ±0.6% by the carbon-polythene difference method. The results are in good agreement with similar measurements made with a hydrogen gas target and were used to define more closely the value of the scattering phase-shifts at 50 Mev. (auth)

18672 PHENOMENOLOGICAL ANALYSIS OF PROTON COMPTON SCATTERING FOR POLARIZED PHOTONS AND PROTONS. G. Eriksson and N. H. Moeller (Univ. of Lund, Sweden). Nucl. Phys., 51: 273-301(Feb. 1964).

The amount of information that can be obtained about the S-matrix for proton Compton scattering is investigated. Compton scattering can be described by six complex amplitudes. Using phase shift analysis, six convenient invariants were constructed. The corresponding six complex amplitudes were calculated. They are expressed as sums of S-matrix elements multiplied by Jacobian polynomials. Knowing the amplitudes, the S-matrix elements can be calculated. The differential cross sections for all kinds of polarization of the particles were expressed in terms of the complex amplitudes. It is shown that all these amplitudes can be determined from experiments, which can be performed at present. (auth)

18673 THE BREAKDOWN OF REFLECTION SYMMETRY AND THE PRINCIPLE OF RESTRICTED COHERENCE. Richard Spitzer (Univ. of California, Livermore). Nucl. Phys., 51: 553-60(Mar. 1964). (UCRL-7496-T)

It is argued that existing information on parity violation suggests that this phenomenon is, in all cases of its occurrence, an expression of the restrictions on the set of observables imposed by the intrinsic space-inversion properties of the states connected by parity-violating processes. Parity conservation in strong phenomena and the absence of purely strong transitions between subspaces connected by parity-violating processes are then interpreted as different manifestations of a single principle that restricts the measurement of purely strong phenomena to be compatible with invariance under space inversion. (auth)

18674 DATA ON ELEMENTARY PARTICLES AND RESONANT STATES, NOVEMBER 1963. Matts Roos (NORDITA, Copenhagen). Nucl. Phys., 52: 1-24(Mar. 1964).

The elementary particle data comprise quantum numbers, mass, magnetic moment, mean life, common decay modes, and branching ratios. The resonant state data comprise quantum numbers, mass, width, life time, threshold laboratory momentum for a production process, decay modes, branching ratios, and Q values. All data used to obtain the tabulated average values, and some data not used are given in 52 footnotes. 198 references. (auth)

18675 PAIR PRODUCTION AND ELECTROMAGNETIC MESON DECAY. Werner Ruehl (Universität, Cologne). Nucl. Phys., 52: 157-76(Mar. 1964).

In analogy to the real Compton process, a one-pion exchange diagram for pair production in the field of a proton is discussed. In this case, a virtual time-like photon corresponds to the final photon of the Compton process. Therefore there are contributions from the production of virtual ω- and ρ-mesons. Consequently, the matrix element shows a resonance behavior, if the energy of the produced pair in its barycentric system equals the mass of a resonant meson. A total cross section formula and two formulas for differential cross sections are given. One of the latter cross sections contains as variables the pair energy and the invariant square of the momentum transfer. It is compared with an analogous cross section for the Bethe-Heitler matrix element in order to examine the separation of the contributions of these two matrix elements. Both these formulas are also programed and tabulated. If small momentum transfers are considered, it turns out that only the peak of the ω-resonance exceeds the Bethe-Heitler background, provided that the energy is low enough. At higher energies this peak vanishes. (auth)

18676 ISOBARS OF ELEMENTARY PARTICLES. M. Cresti (Università, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo Cimento (1), 1: Suppl. No. 1, 86-114(1963). (In Italian)

The most significant data obtained in the last few years on the existence and properties of isobars or resonances of elementary particles are reviewed. For ease of discussion an empirical classification of the isobars is made according to their spin and isotopic spin. The nucleon, pion, K meson, and hyperon isobars for which there is strong independent evidence of their existence are described. In addition the Ξ isobar, the "ABC" anomaly, and unconfirmed isobars are briefly considered. (J.S.R.)

18677 REGGE POLES AND HIGH ENERGY SCATTERING. D. Amati (Università, Palermo, Italy and CERN, Geneva). Nuovo Cimento (1), 1: Suppl. No. 1, 135-50(1963). (In Italian)

Regge proposed to study the analytical properties of the scattering amplitude as a function of the angular momentum considered as a complex variable. The Regge method is briefly considered. Some physical implications of the Regge poles, when it is conceded that the results obtained representing the interaction with a potential can be applied to the relativistic scattering of particles, are discussed. (J.S.R.)

18678 PARTICLE PRODUCTION IN PROTON-PROTON COLLISIONS AT 19 AND 24 Bev/c. A. N. Diddens, W. Galbraith, E. Lillethun, G. Manning, A. G. Parham, A. E. Taylor, T. G. Walker, and A. M. Wetherell (CERN, Geneva). Nuovo Cimento (10), 31: 961-73(Mar. 1, 1964).

Cross sections for production of d, $\pi^{\pm}$, $K^{\pm}$, and $p^{\pm}$ were measured at a laboratory angle of 116 mrad for p-p interactions at 19 and 24 Bev/c. The observed spectra are compared with statistical-model calculations. Significant cross sections were found for the production of deuterons of momenta in the range 2 to 9 Bev/c and with transverse momenta up to 1 Bev/c. (auth)

18679 Λ-NUCLEON SCATTERING IN K^--DEUTERIUM CAPTURE REACTIONS AT REST. Ramesh Chand (Syracuse Univ., N. Y.). Nuovo Cimento (10), 31: 1013-24 (Mar. 1, 1964).

In the multiple scattering formalism, Λ-nucleon interactions in K^--deuterium absorption processes for K^--capture at rest are discussed as functions of Λ-N scattering parameters. It is found that the pion-momentum spectrum and the Λ-productions rate are surprisingly insensitive to the details of Λ-nucleon interactions. (auth)

18680 REGGE-POLE THEORY OF THE PHOTOPRODUCTION OF PIONS. N. Dombey (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 31: 1025-36 (Mar. 1, 1964).

In an attempt to apply a Regge-pole treatment to photoproduction it was found that in order to obtain the desired results massive photons have to be introduced into the theory to allow for effects arising from longitudinal polarization of the photon. A new set of invariant amplitudes for the electroproduction of pions naturally suggest themselves from these considerations. (auth)

18681 THE LEE MODEL AND THE ρ-MESON. D. W. Joseph (Naval Research Lab., Washington, D. C.) and W. W. Wada. Nuovo Cimento (10), 31: 1070-8(Mar. 1, 1964).

The Lee model with cut-off is adapted to the case of a spin-one V particle interacting with two spin-zero particles in a p-wave state. The $\rho^0 \longleftrightarrow \pi^+\pi^-$ system is then discussed in terms of this (much simplified) model. It is found, as might be expected, that the ρ-meson pole (on the second sheet) dominates $\pi\pi$ scattering in the model, and that the renormalized coupling constant is essentially independent of the cut-off. (auth)

18682 BOUND FOR THE HIGH-ENERGY NUCLEON-NUCLEON SCATTERING AMPLITUDE AT ANGLE $\neq 0$ OR π AND AT FIXED MOMENTUM TRANSFER $\neq 0$. H. Cornille (CERN, Geneva). Nuovo Cimento (10), 31: 1101-15 (Mar. 1, 1964).

Previously used methods for determining bounds for high-energy scattering of spinless particles at fixed angle are extended to find bounds for the scattering of particles with spin $\frac{1}{2}$, $\frac{1}{2}$: nucleon-nucleon scattering. It is found that the extension of results to nucleon-nucleon scattering is made by replacing Legendre polynomials by Jacobi polynomials in the amplitude expansion, taking advantage of the great similarity of their properties. The main results are: (1) for forward scattering (with $\theta \neq 0$), for four of the five linearly independent helicity amplitudes, the same energy- and angle-dependence is found for the bounds as in the spinless case, the fifth giving a slightly supplementary term; (2) for backward scattering (with $\theta \neq \pi$) a symmetric situation; (3) at fixed physical momentum transfer $\neq 0$, the same energy-dependence is found as in the spinless case. (auth)

18683 ON THE PERATIZATION OF NUCLEON-LEPTON INTERACTIONS. G. Costa, A. Galindo, F. Hadjioannou, and A. Morales (CERN, Geneva). Nuovo Cimento (10), 31: 1116-20(Mar. 1, 1964).

The peratization method of Feinberg and Pais is applied to lepton-nucleon interactions, examining possible effects of the nucleon vertex structure. In this case, the correction to the coupling constant, due to the contribution of the ladder graphs at zero momentum-transfer, is different, in general, from that obtained in the pure leptonic case. (auth)

18684 ON THE $\pi-\omega$ RESONANCE (B-MESON). S. Minami (Louisiana State Univ., Baton Rouge). Nuovo Cimento (10), 31: 1133-6(Mar. 1, 1964).

The properties of the B-meson ($\pi-\omega$) are discussed from a phenomenological viewpoint and B-meson reactions are studied kinematically. On the basis of a previously suggested selection rule, the existence of a 1^{+-} meson with I = 0 that is to be observed as a resonance state in the $\pi-\rho$ system is predicted. (R.E.U.)

18685 π^+ PHOTOPRODUCTION AT CONSTANT PION ENERGY, AND THE $(\gamma\pi\rho)$ COUPLING. D. W. G. S. Leith, R. Little, and E. M. Lawson (Glasgow Univ.). Phys. Letters, 8: 355-7(Mar. 1, 1964).

The absolute differential cross sections for π^+ photoproduction from hydrogen were measured at 21.3, 33.8, and 68.5 Mev pion kinetic energy (lab) in an effort to determine Λ, the strength of the $(\gamma\pi\rho)$ coupling. It is concluded that photoproduction data can be adequately explained without recourse to a $(\gamma\pi\rho)$ term. The existence of such a term is not disproved, but rather that the many uncertainties, such as the values of the small p-wave phase shifts, and beam monitoring normalization, make attempts to isolate a ρ-meson effect very unreliable. 21 references. (R.E.U.)

18686 A REMARKABLE REPRESENTATION OF THE WEAK AND ELECTROMAGNETIC LAGRANGIAN. P. T. Matthews and A. Salem (Imperial Coll. of Science and Tech., London). Phys. Letters, 8: 357-8(Mar. 1, 1964).

The structure of SU(3) is used to explain a particular angle that is introduced into the weak Lagrangian terms for strongly interacting particles by rotation of the axes of Unitary Symmetry. Spinor combinations are found that have the property of a group theoretic quantity, which involves J^+ and the neutral currents only through J^0. (R.E.U.)

18687 COMPLEX ANGULAR MOMENTUM AND DIFFRACTION SCATTERING. I. R. Gatland and J. W. Moffat (Research Inst. for Advanced Studies, Baltimore). Phys. Letters, 8: 359-61(Mar. 1, 1964).

Analytical behavior in the t-plane for $\alpha_p(t)$, f(t), and h(t) is introduced into a model for high-energy scattering dominated by a vacuum intermediate state that exhibits a pole and a fixed branch cut in the angular momentum plane (see NSA, 17: 37958). $\alpha_p(t)$ is the Pomeranchuk trajectory, f(t) is the form factor, and $h(t) = g(t)/\alpha_p(t)f(t)$, where g(t) is the residue of the Regge pole. This reduces the arbitrariness in the model and allows a fit of recent K^+p and K^-p data and improved determination of α_p and h. An effective-range approximation is used to make experimental comparisons that consist of replacing the right-hand branch cut in the t-plane by a single pole. (R.E.U.)

18688 INTERMEDIATE VECTOR MESONS AND UNITARY SYMMETRY. S. Okubo (Univ. of Rochester, N. Y.). Phys. Letters, 8: 362-4(Mar. 1, 1964). (UR-875-19)

A theory is formulated of the weak interaction in connection with the unitary symmetry model by introducing charged and neutral intermediate vector mesons. It is assumed that weak baryonic currents of the interaction are components of some unitary octet and that the resulting effective interaction of nonleptonic, strangeness-violating processes is also a component of another unitary octet. Four distinct vector mesons are used to satisfy the theory. (R.E.U.)

18689 DIFFERENCE IN MASS BETWEEN THE Y_1^{*-} AND Y_1^{*+} ISOBARS. W. A. Cooper (CERN, Geneva), H. Filthuth, A. Fridman, E. Malamud, E. S. Gelsema, J. C. Kluyver, and A. G. Tenner. Phys. Letters, 8: 365-7(Mar. 1, 1964).

Interactions of 1.455-Bev/c mesons (K^-) in a hydrogen bubble chamber were analyzed for events of the type $K^-p \rightarrow Y_1^*(1385)\pi \rightarrow \Lambda^0\pi^+\pi^-$. Effective masses of $\Lambda^0\pi^+$ and $\Lambda^0\pi^-$ in the region of the $Y_1^*(1385)$ resonance were plotted and a mass difference $(Y_1^{*-} - Y_1^{*+})$ of (17 ± 7) Mev was found. Possible systematic errors are discussed. (R.E.U.)

18690 ISOTOPIC SPLITTING OF THE PION NUCLEON S STATE INTERACTION BY INELASTICITY. H. Goldberg and E. L. Lomon (Massachusetts Inst. of Tech., Cambridge). Phys. Letters, 8: 368-70(Mar. 1, 1964). (TID-20089)

Isotopic spin independence in even orbital angular momentum states for $T = \frac{1}{2}$ pion-nucleon interactions is discussed. S-wave isotopic splitting mechanisms are discussed with and without dipion intermediate states. Strong structural effects in the S_{11} channel due to the production of the T = 0 dipions on the energy shell are discussed. (R.E.U.)

18691 POLE APPROXIMATION AND UNITARY SYMMETRY IN NON-LEPTONIC DECAYS OF HYPERONS. G. Murtaza and M. A. Rashid (Imperial Coll. of Science and Tech., London). Phys. Letters, 8: 370-1(Mar. 1, 1964).

The decay rates for hyperons are calculated in the pole approximation scheme assuming that the nonleptonic decay amplitudes are dominated by the baryon and K-meson pole terms and that the unitary symmetry is valid for the strong vertices. (R.E.U.)

18692 ISOBAR PRODUCTION AND THE SU_3 SYMMETRY. H. Sugawara (Tokyo Univ.). Phys. Letters, 9: 60-2(Mar. 15, 1964).

The isobar production processes $\pi^- + p \rightarrow \pi + N_{33}^*, K^- +$

$p \rightarrow \pi + Y_{31}^*$, and $K^- + p \rightarrow K + N_{33}^*$ are discussed. The incident momenta are 900 Mev/c for the mesons (π^-) and 1500 Mev/c for the mesons (K^-). The SU_3 octet symmetry is used. (C.E.S.)

18693 MEASUREMENT OF THE e^+ POLARISATION IN MUON DECAY BY MEANS OF BHABHA SCATTERING. J. Duclos, J. Heintze, A. De Rujula, and V. Soergel (CERN, Geneva). Phys. Letters, 9: 62-5(Mar. 15, 1964).

A method that permits an absolute measurement of the polarization of positrons from meson (μ^+) decay without slowing down the positrons is described. The method uses positron-electron (Bhabha) scattering in magnetized iron. The magnetized iron provides a target of polarized electrons, and the positron polarization can be evaluated from the scattering asymmetry. (C.E.S.)

18694 DYNAMICAL MODEL FOR AN OCTET CONTAINING THE $\pi\omega$ RESONANCE. G. Goebel (Univ. of Wisconsin, Madison). Phys. Letters, 9: 67-8(Mar. 15, 1964).

A dynamical model is proposed for the $K\pi\pi$ resonance. It is assumed that this resonance is a member of a unitary symmetry (SU_3) multiplet to which the $\pi\omega$ resonance (1220 Mev) belongs. (C.E.S.)

18695 ANTIBOUND STATES OF THE PION–PION SYSTEM. D. Atkinson (CERN, Geneva). Phys. Letters, 9: 69-70(Mar. 15, 1964).

It is shown that dispersion relations strongly indicate an antibound state in the I = 0, S state of the reaction $\pi + \pi \rightarrow \pi + \pi$ close to the threshold. A possible antibound state occurs in the I = 2, S wave, but much further from the threshold. No antibound state is indicated for the I = 1 amplitude. (C.E.S.)

18696 EVIDENCE FOR A $K\pi\pi$ RESONANCE. T. P. Wangler, A. R. Erwin, and W. D. Walker (Univ. of Wisconsin, Madison). Phys. Letters, 9: 71-2(Mar. 15, 1964).

Four body strange particle final states produced by a 3.0-Bev/c meson (π^-) beam in a bubble chamber seem to indicate a resonance in the $K\pi\pi$ system. The resonance appears to be produced in association with both hyperons (Λ) and (Σ) in the final states $\pi^- + p \rightarrow \pi\pi K\Lambda$ and $\pi^- + p \rightarrow \pi\pi K\Sigma$. (C.E.S.)

18697 EVIDENCE FOR AN ANOMALY IN TWO PION PRODUCTION. R. J. Homer (Univ. of Birmingham, Eng.), Q. H. Khan, W. K. McFarlane, J. S. C. McKee, A. W. O'Dell, L. Riddiford, P. G. Williams, and D. Griffiths. Phys. Letters, 9: 72-5(Mar. 15, 1964).

A search for a previously observed attractive interaction between two mesons (π) in an I = 0 state was conducted by investigating the momentum spectrum of deuterons from the reaction $p + n \rightarrow d + 2\pi$ at an incident proton energy of 991 Mev. In this reaction the mesons (π) may be in either an I = 0 or I = 1 state. To determine the I = 1 contribution the reaction $p + p \rightarrow d + 2\pi$ was also studied. (C.E.S.)

18698 A NEARBY SINGULARITY PREDICTION OF A RESONANCE. B. Diu and H. R. Rubinstein (Theorique et Hautes Energies, Orsay, France). Phys. Letters, 9: 76-7 (Mar. 15, 1964).

Evidence is presented for the existence of a resonance with quantum numbers B = 0, S = 0, $I^G = 1^-$, and $J^P = 0^+$. The evidence is based on a plausible assumption and can be tested by experiment. The quantum numbers of the resonance are such that it is not coupled to 2π, 3π, or 4π. The lowest lying two-body channels in which it will appear are $\pi + \eta$, $K + \overline{K}$, and $\rho + \omega$. (C.E.S.)

18699 ASYMPTOTIC RELATIONS BETWEEN PHOTOPRODUCTION AMPLITUDES. Nguyen Van-Hieu (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Letters, 9: 81-2(Mar. 15, 1964).

The asymptotic relations between amplitudes of meson photoproduction processes on baryons are studied. The reactions $\gamma + p \rightarrow \pi^0 + p$, $\gamma + n \rightarrow \pi^0 + n$, $\gamma + p \rightarrow K^0 + \Sigma^+$, $\gamma + \Sigma^+ \rightarrow \overline{K}^0 + p$, $\gamma + n \rightarrow K^0 + \Lambda$, and $\gamma + \Lambda \rightarrow \overline{K}^0 + n$ are discussed. (C.E.S.)

18700 INVARIANCE PROPERTIES AND ASYMPTOTIC RELATIONS BETWEEN SCATTERING AMPLITUDES. Nguyen Van-Hieu (Joint Inst. for Nuclear Inst., Dubna, USSR). Phys. Letters, 9: 83-4(Mar. 15, 1964).

The role of P, C, and T invariance properties in the proof of the asymptotic relations between cross sections and polarizations in crossed meson-baryon scattering processes is examined. It is shown that parity conservation does not play any role, but that T-invariance is very important. The scattering processes $\pi^+ + p \rightarrow K^+ + \Sigma^+$ and $\pi^- + \Sigma^+ \rightarrow K^- + p$ are discussed. (C.E.S.)

18701 ANALYSIS OF THE 142 Mev PROTON-PROTON SCATTERING DATA. Peter Signell and D. G. Marker (Pennsylvania State Univ., University Park). Phys. Rev., 134: B365-73(Apr. 27, 1964).

After some amount of data selection, modified phase-shift analyses were made on the 137.5–147-Mev proton-proton scattering data. Standard deviations were obtained for phase shifts of the Stapp-Ypsilantis-Metropolis solution type 1. As previously reported by Perring, solution 2 was found to be very improbable. The pion-nucleon coupling constant was not well defined by the data at this energy. The Amati-Leader-Vitale phases were examined, and several discrepancies noted. Further experiments are suggested. (auth)

18702 PRODUCTION OF STRANGE PARTICLES BY 2.77-Bev/c π^+ MESONS ON HYDROGEN. S. S. Yamamoto, L. Bertanza, G. C. Moneti, D. C. Rahm, and I. O. Skillicorn (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 134: B383-7(Apr. 27, 1964). (BNL-7644)

A liquid-hydrogen bubble chamber was exposed to a beam of 2.77-Bev/c separated π^+ mesons. In a detailed study involving strange-particle production the well-known K^* (mass 900 Mev) and Y_1^* (mass 1385 Mev) were observed. The former was produced in the final state $\Sigma^+\pi^+K^0$ and the latter in the states $\pi^+\pi^+\Lambda^0K^0$ and $\pi^+K^+\Lambda^0$. It was necessary to include both K and K^* exchanges in order to explain the K^* decay angular distributions. The decay angular distribution of the Y_1^* gave evidence for a strong Y_1^* polarization as well as spin $\geq 3/2$. Furthermore, an examination of the reaction $\pi^+pK^0K^0$ showed that the (π^+p) emerged as $N_{\delta,\delta}^*$ coupled with a (K^0K^0) enhancement in the mass region from 1000 to 1040 Mev. (auth)

18703 DYNAMICAL MODEL OF THE 1535-Mev Ξ^* HYPERON. Jogesh C. Pati (Brookhaven National Lab., Upton, N. Y. and Univ. of Maryland, College Park). Phys. Rev., 134: B387-96(Apr. 27, 1964).

An attempt is made to understand the dynamical origin of the 1535-Mev Ξ^* hyperon. The problem of scattering in the $J = 3/2^+$-state of the $\overline{K}\Lambda$-channel is studied by the N/D method. The influence of all other channels is ignored. The dynamical singularities of the partial-wave amplitude are assumed to arise mainly from the nearby cut (due to the nucleon exchange in the crossed channel) and the far left-hand cut ($-\infty < S \leq 0$). The contribution of the former is evaluated explicitly in terms of the ΛNK coupling constant and that of the latter, by the method of Balázs, through the introduction of the effective range pole terms. The analysis is found to be quite insensitive to the choice of the ΛNK coupling constant. The D function is found to have the

desired behavior for the occurrence of a resonance or bound state in the energy region of interest. The main force for the existence of the resonance or bound state seems to arise from the singularities associated with the far left-hand cut. The best set of self-consistent solutions for the position and residue indicates the presence of a bound state in the $J = \frac{3}{2}^+$ state of $\bar{K}\Lambda$ system at $S_R \approx 109\ m_\pi^2$ with residue $K_{\Sigma^*} \approx 10$. (auth)

18704 BOUNDS ON MULTICHANNEL SCATTERING PARAMETERS. Yukap Hahn, Thomas F. O'Malley, and Larry Spurch (New York Univ., New York). Phys. Rev., 134: B397-404(Apr. 27, 1964).

Using the projection techniques recently developed in the formal theory of reactions, it is shown that a bound on the exact reactance matrix K is provided by the close-coupling reactance-matrix approximation K^P; that is, $K-K^P$ is, in a sense that can be made precise, a positive definite operator. This is of more than formal interest since the numerical solution of the finite number of coupled equations that arise when the target system is excited to only a restricted number of virtual states, and the determination of K^P, is feasible for a variety of three-body problems that include, of course, three-body model problems. Furthermore, K^P improves monotonically as one includes more and more virtual states. The recognition of this monotonicity property is useful in self-consistency analyses during the course of numerical calculations and provides a more precise meaning for the numerical results obtained. Choosing a particular representation, the bound on K generates bounds on the appropriately defined eigenphase shifts. The question of the absolute definition of phase shifts and of eigenphase shifts is discussed in some detail, and it is shown that the presently used definition has serious deficiencies. (auth)

18705 RELATIVISTIC CALCULATION OF THE DEUTERON ELECTROMAGNETIC FORM FACTOR. [PART] I. Franz Gross (Princeton Univ., N. J.). Phys. Rev., 134: B405-19(Apr. 27, 1964).

The foundations of a relativistic theory of the deuteron-electromagnetic form factor are discussed. The theory is based on single-variable unsubtracted dispersion relations and coupled unitarity equations. Because of the presence of very low anomalous thresholds, only a few diagrams need be considered to give a satisfactory low-momentum transfer theory, and the diagrams with thresholds below 36 μ^2 are tabulated. The scalar theory for a subset of these diagrams (corresponding to a one-pion-exchange approximation) is examined and found to be in close correspondence with potential theory. Special attention is given to the anomalous thresholds. The role of the 3-pion state is discussed. (auth)

18706 FEINBERG-PAIS EQUATION FOR THE TRACE OF LADDER DIAGRAMS. J. C. Polkinghorne and J. C. Taylor (Cambridge Univ., Eng.). Phys. Rev., 134: B420-3 (Apr. 27, 1964).

The equations of Feinberg and Pais for the trace of the sum of ladder diagrams in lepton scattering are examined by summing Feynman diagrams, and also in configuration space. Both methods establish the truth of a conjecture made by Feinberg and Pais: that the equation is equivalent to one that may be iterated without generating divergent integrals. (auth)

18707 CANONICAL FORM OF THE WAVE EQUATIONS FOR MASSLESS PARTICLES AND THEIR OBSERVABLES. A. Sankaranarayanan (Ames Lab., Ames, Iowa). Phys. Rev., 134: B424-7(Apr. 27, 1964). (IS-775)

Canonical forms of the wave equations for the neutrino and for the photon were derived, and operators for the position and other dynamical variables were suggested. (auth)

18708 INFRARED DIVERGENCE OF THE ANGULAR MOMENTUM OF BREMSSTRAHLUNG AND THE PHYSICAL STRUCTURE OF THE ELECTRON. G. Q. Hassoun and D. R. Yennie (Univ. of Minnesota, Minneapolis). Phys. Rev., 134: B436-44(Apr. 27, 1964).

In a private communication, Biedenharn pointed out that the statistical independence of photon emission in the infrared limit in a bremsstrahlung scattering process may lead to a logarithmically divergent angular momentum for the radiated photons and the scattering system. It is shown that the expectation values of these angular momentum vectors are free of infrared divergence, but the expectation values of their squares are infinite due to an infrared divergence. The physical significance of this result is that an incident electron of arbitrarily large impact parameter can scatter from a finite range potential. This may be ascribed to the physical structure of the electron, namely its photon cloud. (auth)

18709 ASYMPTOTIC CONDITIONS AND INTEGRAL EQUATIONS FOR NONRELATIVISTIC INVARIANT FUNCTIONS. M. Bolsterli and J. F. Walker (Univ. of Minnesota, Minneapolis). Phys. Rev., 134: B444-7(Apr. 27: 1964).

The asymptotic behavior of the invariant functions introduced previously is investigated. It is shown that there exists a direct invariant function and that all scattering amplitudes for single-particle processes can be expressed in terms of this direct function and the asymptotic plane-wave part only of other invariant functions. Moreover, only the short-range part of the potentials enters into the expression for the scattering amplitude. (auth)

18710 MODEL FOR THE INTERACTION $p + p \rightarrow d + \pi^+$ IN THE Bev REGION. Tsu Yao (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 134: B454-9(Apr. 27, 1964). (BNL-7437)

The reaction $p + p \rightarrow d + \pi^+$ in the Bev region is studied within the one-pion-exchange model with final-state interaction between the neutron and proton to form the deuteron. A simple approximate evaluation of the loop integral gives the final differential cross section in terms of the pion-nucleon coupling constant, the deuteron wave function normalization, the πp elastic scattering cross section, and the Ferrari-Selleri form factor. Comparisons with the limited experimental results are made, and fairly good agreement is obtained. The large forward scattering cross section near c.m. energy 3.0 Bev is explained in terms of the large backward $\pi^+ p$ elastic scattering cross section at πp c.m. energy 1.92 Bev [$I = \frac{3}{2}$, $J = \frac{7}{2}$(?) resonance]. Further implications of the calculation are discussed. (auth)

18711 SELF-CONSISTENT SETS OF MESONS IN A BOOTSTRAP MODEL. Richard H. Capps (Northwestern Univ., Evanston, Ill.). Phys. Rev., 134: B460-71(Apr. 27, 1964).

Considerations are given to the possibility that the self-consistency requirements of some dispersion-theoretic bootstrap model may specify uniquely the set of strongly interacting particles found in nature. The discussion is based on a particular, approximate model of the P (pseudoscalar) and V (vector) mesons. In this model the V exchange forces in the P + P states produce the V mesons, and the V exchange forces in the P + V states produce the P mesons. Attention is limited to systems in which the particles arising in a particular way are degenerate or nearly degenerate, and are represented by a small number of irreducible representations of a simple Lie group of first, second, or third

rank. Three plausible self-consistency requirements are postulated. The smallest meson set that satisfies all three postulates corresponds to the group SU_3. The predicted particles in this scheme are a P-meson octet, a V octet, a V singlet, and a singlet particle of spin and parity 2^-. One of the self-consistency postulates is concerned with deviations from degeneracy, and leads to the Gell-Mann-Okubo sum rule for the SU_3 scheme. The double septet scheme of the group G_2 does not satisfy any of the postulates. (auth)

18712 TRANSPORT THEORY FOR ELECTRON-PHONON INTERACTIONS IN METALS. Richard E. Prange (Univ. of Maryland, College Park) and Leo P. Kadanoff. Phys. Rev., 134: A566-80(May 4, 1964).

By extending Migdal's approximation for electron-phonon interactions in metals to the nonequilibrium case, it is possible to derive a set of transport equations that are exact to order $(m/M)^{\frac{1}{2}}$. This coupled set of equations for the electron and phonon distribution functions is correct even in the situation in which the electronic excitation spectrum has considerable width and structure so that one might not expect a priori that there would be well-defined quasiparticles. Nonetheless, one of the forms of the electronic transport equation is identical to the transport equation suggested by Landau for the case in which the quasiparticle energy is well defined. The transport equations may be written in two different forms: In the first form, the electronic distribution function is labeled by a momentum vector; in the second, the labels are excitation energy and the position on the Fermi surface. Despite the width in the spectrum, the momentum-space form is identical with the Landau quasiparticle theory. The energy space form is slightly simpler because no wave function renormalization constants appear in the definition of the energies or in the scattering matrix elements. In fact, in the case in which there is space dependence but no time dependence this form of the transport equations looks identical to the weak-coupling Boltzmann equations. This identity is used to prove that to the accuracy of the adiabatic approximation the several transport coefficients are completely unchanged by the many-body effects of the electron-phonon interaction. These coefficients, which include the spin diffusivity and the viscosity as well as the ordinary conductivities and all the classical galvanomagnetothermal effects are thus correctly predicted by the standard weak-coupling theory. Many-body effects are also absent in $dn/d\mu$ and the spin susceptibility; however, they do appear in the specific heat and in the response to time-dependent disturbances. (auth)

18713 NONLEPTONIC DECAYS OF BARYONS AND THE EIGHTFOLD WAY. Yasuo Hara (California Inst. of Tech., Pasadena). Phys. Rev. Letters, 12: 378-9(Mar. 30, 1964).

It is shown, under the same assumptions made for forbidden $K_1^0 \rightarrow 2\pi$ decays in unitary symmetry limit, that poles due to octet baryon resonance (B_8^+) must be included in the pole approximation for nonleptonic weak decay of baryon resonances and that the parity-violating amplitudes of the γ decays, $\Sigma^+ \rightarrow p + \gamma$ and $\Xi \rightarrow \Sigma^- + \gamma$, are zero. (L.B.S.)

18714 UNITARY SYMMETRY MODEL OF WEAK INTERACTIONS. Bunji Sakita (Univ. of Wisconsin, Madison). Phys. Rev. Letters, 12: 379-82(Mar. 30, 1964). (TID-20280)

A model of weak interactions based on unitary symmetry of strong interactions and on the V-A theory of weak interactions is presented. It is assumed that the weak interaction currents of strongly interacting particles have positive RC conjugation parity. Nonleptonic decay of hyperons is analyzed and eight independent SU(3) coupling schemes are constructed. It is predicted that Σ^- decay is almost pure S-wave decay. (L.B.S.)

18715 UNITARITY, ABSORPTIVE PROCESSES, AND SINGLE-PARTICLE EXCHANGE MODELS AT HIGH ENERGIES. Loyal Durand, III, and Yam-tsi Chiu (Yale Univ., New Haven). Phys. Rev. Letters, 12: 399-403 (Apr. 6, 1964).

A modified single-particle exchange model, which takes into account absorptive effects, is discussed. This model is applied to an analysis of data on the $\bar{p} + p \rightarrow \bar{\Lambda} + \Lambda$ and $\bar{p} + p \rightarrow \bar{N}^* + N^*$ reactions. The results show remarkable improvement in the angular distribution dependence of the reaction cross sections and changes in the supposed reaction mechanism and behavior of vertex functions involving the exchanged particles. (L.B.S.)

18716 UNITARITY CORRECTIONS TO BORN AMPLITUDES FOR NUCLEON-NUCLEON SCATTERING. Malcolm H. MacGregor (Univ. of California, Livermore). Phys. Rev. Letters, 12: 403-6(Apr. 6, 1964). (UCRL-7664-T)

A correction scheme applied to Born amplitudes for calculating the resonance contributions to the larger low-angular-momentum phase shifts in nucleon-nucleon scattering is proposed. Calculated results for $^1P_1$, $^1D_2$, and $^1F_3$ nucleon-nucleon phase shifts are tabulated. (L.B.S.)

18717 UNITARY SYMMETRY AND WEAK INTERACTIONS. S. P. Rosen (Purdue Univ., Lafayette, Ind.). Phys. Rev. Letters, 12: 408-11(Apr. 6, 1964).

The possibility of deriving the relations between the assymetry parameters, within the framework of unitary symmetry, for nonleptonic modes of Σ, Λ, and Ξ decay from the $\Delta T = \frac{1}{2}$ rule, time reversal invariance, and two symmetry principles is shown. (L.B.S.)

18718 A SURVEY OF NEW PARTICLES. P. S. Gill (Muslim Univ., Aigarh, India). Proc. Natl. Inst. Sci. India, Pt. A, 28: 207-12(Mar. 26, 1962).

A survey is given of elementary particles and resonances. (T.F.H.)

18719 A SURVEY OF PRESENT-DAY APPROACHES TO STRONG INTERACTIONS. A. N. Mitra (Univ. of Delhi). Proc. Natl. Inst. Sci. India, Pt. A, 28: 213-22(Mar. 26, 1962).

Theoretical tools for handling strong interactions are reviewed, with emphasis on the strong-coupling and intermediate-coupling theories, the method of functional integrations, and soluble field-theoretical models. (T.F.H.)

18720 ON RELATIVISTIC DISPERSION RELATIONS. P. K. Roy (University Coll. of Science, Calcutta). Proc. Natl. Inst. Sci. India, Pt. A, 28: 223-7(Mar. 26, 1962).

An outline is given of the use of one- and two-dimensional relativistic dispersion relations for studies of scattering processes. (T.F.H.)

18721 SCALAR INTERACTION OF TWO SCALAR MESONS. S. P. Misra (Ravenshaw Coll., Cuttack, India). Proc. Natl. Inst. Sci. India, Pt. A, 28: 261-5(Mar. 26, 1962).

We have considered the case of two scalar mesons with scalar interaction, which is actually equivalent to two non-interacting scalar fields with renormalized masses. This exact result is compared with the solution in terms of "bare" particle states. It is noted that such a solution does not exist; but we find that if we take an infinite field operator renormalization, an approximately correct solution is obtained. Thus we have an example where an exact solution exists, but an attempt to express the solu-

tion in terms of "bare" particles gives rise to spurious infinities. (auth)

18722 BOSON-PAIR TERMS OF THE CHARGED CURRENTS IN THE SCHIZON THEORY OF WEAK INTERACTIONS. B. Banerjee and S. N. Biswas (Tata Inst. of Fundamental Research, Bombay). Proc. Natl. Inst. Sci. India, Pt. A, 28: 272-6(Mar. 26, 1962).

The immediate consequences of the introduction of strangeness-conserving as well as nonconserving charged currents involving bosons only have been considered in the light of the intermediate schizon theory of weak interactions. It is pointed out among others that the $K_1^0\ \pi$ current has to be discarded if the interaction is via the intermediate boson. (auth)

18723 LEPTONIC DECAY OF HYPERONS. Haridas Banerjee (Indian Inst. of Tech., Khargpur, India) and Prabahan Kabir. Proc. Natl. Inst. Sci. India, Pt. A, 28: 277-81(Mar. 26, 1962).

Calculations of these decays are not mutually consistent. We have therefore recalculated the rate of such processes, assuming a local Fermi interaction containing only V and A covariants. Our result agrees with calculations of the decay rate only for the case of vanishing lepton mass. (auth)

18724 ELECTROMAGNETIC WAVE DIFFRACTION ON A SPACE-PERIODIC LATTICE MADE UP OF SQUARE BARS. S. A. Masalov and I. E. Tarapov. Radiotekhn. i Elektron., 9: 53-60(Jan. 1964). (In Russian)

A numerical solution is given for a problem on polarized electromagnetic wave diffraction in normal incidence on an ideally conducting lattice of square metal bars. Graphs were constructed for propagation coefficients as functions of lattice period, lattice thickness, and wave length. (R.V.J.)

18725 SEARCH FOR $\omega \to e^+ + e^-$ DECAY. V. V. Barmin, A. G. Dolgolenko, Yu. S. Krestnikov, A. G. Meshkovskii, and V. A. Shebonov (Inst. of Theoretical and Experimental Physics, USSR). Zh. Eksperim. i Teor. Fiz., 45: 2082-4(Dec. 1963). (In Russian)

Probabilities of the ω decay scheme $\omega \to e^+ + e^-$ were analyzed previously, and it was shown that the ratio $R = w(\omega \to e^+ + e^-)/w(\omega \to \lambda^+ + \lambda^- + \pi^0)$ is of the order $\sim 10^{-2}$. A reaction $\pi^- + p \to n + X^0 (X^0 \to e^+ + e^-)$ (where X^0 is an arbitrary neutral particle decaying into $X^0 \to e^+ + e^-$) was studied in order to find the decay $\omega \to e^+ + e^-$. The reaction was studied using 1.55- and 2.8-Bev π^- meson pulses and a xenon–propane bubble chamber. Four verified double-prong star events and three not completely proven events were found from 20,000 stereopictures at 1.55 Bev/c, and 40,000 at 2.8 Bev/c. The results of the analysis are in good agreement with theoretical results and preliminary data. (R.V.J.)

18726 TRIPLE SCATTERING OF 660-Mev PROTONS. IV. ANGULAR DEPENDENCE OF PARAMETER. Yu. P. Kumekin, M. G. Mescheryakov, S. B. Nurushev, and G. D. Stoletov (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 46: 50-8(Jan. 1964). (In Russian)

Experiments on triple scattering of protons are carried out in investigation of pp interaction at ~660 Mev. The experimental conditions are described and the results of measurement of parameter A for angles of 54, 72, 90, 108, and 126° in the c. m. s. are reported. The results obtained and also those of other experiments are employed for direct reconstruction of the pp scattering matrix and also for comparing with the results of various variants of phase shift analysis. (auth)

18727 ESTIMATION OF THE RELATIVE PROBABILITY FOR THE $K_2^0 \to 3\pi^0$ DECAY. M. Kh. Anikina, M. S. Zhuravleva, D. M. Kotlyarevskii. et al. (Joint Inst. for Nuclear Research, Dubna, USSR and Inst. of Physics, Academy of Sciences, Georgian SSR). Zh. Eksperim. i Teor. Fiz., 46: 59-66 (Jan. 1964). (In Russian)

The probability for $K_2^0 \to 3\pi^0$ decay relative to that for all K_2^0-meson decays into charged particles is obtained experimentally and found to be (0.24 ± 0.08). (auth)

18728 INVESTIGATION OF INELASTIC COLLISIONS BETWEEN 2.8 Bev/c π^- MESONS AND PROTONS. Yu. V. Trebukhovskii, I. A. Erofe'ev, and G. D. Tikhomirov (Inst. of Experimental and Theoretical Physics, USSR). Zh. Eksperim. i Teor. Fiz., 46: 99-105(Jan. 1964). (In Russian)

The $\pi^- + p \to p + \pi^- + m\pi^0$ reaction on hydrogen was studied in a propane-xenon chamber for 2.8 Bev/c π^--mesons. It is shown that a ρ^--meson is formed with a cross section $\sigma = 0.30 \pm 0.07$ mb for transferred momenta in the 0.2–0.4 Bev/c range. An irregularity in the distribution of residual masses is observed at the value $M_x = 1.00 \pm 0.01$ Bev with a half-width 60 ± 20 Mev which corresponds to the final state π^-, π^0, π^0. The cross section for this process in the indicated region of momenta transferred to the proton is $\sigma = 0.16 \pm 0.05$ mb. (auth)

18729 AN INVESTIGATION OF CHARGE-EXCHANGE $\pi^- + p \to n + \pi^0$ AND $\pi^- + p \to n + \eta(\eta \to 2\gamma)$ REACTION IN 1,55–4,5 Bev/c REGION. V. V. Barmin, A. G. Dolgolenko, Yu. S. Krestnikov, A. G. Meshkovskii, and V. A. Shebanov (Inst. of Theoretical and Experimental Physics, USSR). Zh. Eksperim. i Teor. Fiz., 46: 142-7(Jan. 1964). (In Russian)

In a 17-liter propane-xenon bubble chamber charge-exchange $\pi^- + p \to n + \pi^0$ and $\pi^- + p \to n + \eta(\eta \to 2\gamma)$ reactions were investigated in 1.55–4.5 Bev/c region. Total cross section of both reactions were measured in this region. Angular distributions of π^0-mesons in charge-exchange were obtained. Cross sections for charge-exchange around 180° were estimated. (auth)

18730 MEASUREMENT OF THE POLARIZATION OF PROTONS ELASTICALLY SCATTERED ON D^2, T^3, AND He^3 NUCLEI. N. A. Skakun, A. G. Strashinskii, and A. P. Klyucharev (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 46: 167-70(Jan. 1964). (In Russian)

The polarization of protons scattered on ^{3}He is measured for energies between 2.7 and 4 Mev and a scattering angle of 40°. With growth of energy above 2.5 Mev an appreciable polarization appears which reaches a maximum [$P = (30 \pm 5)\%$] at E = 3.37 Mev; at higher energies the polarization begins to drop off. Protons scattered on tritium at an angle of 40° and energy 3.0 Mev are almost unpolarized. At 3.48 Mev the polarization is $(-22 \pm 11)\%$. The polarization of 3.1- and 3.3-Mev protons scattered on deuterium is insignificant. Polarization analysis was performed by using ^{4}He. Doubly scattered protons were recorded with photographic plates. (auth)

18731 ANGULAR CORRELATIONS NEAR THE THRESHOLD OF FORMATION OF AN UNSTABLE PARTICLE. L. M. Lazarev. Zh. Eksperim. i Teor. Fiz., 46: 176-81(Jan. 1964). (In Russian)

The X(a,b)Y* reaction is considered. The Y* particle is unstable and during a time $\tau \sim \Gamma^{-1}$ decays into two particles. The angular dependence of the reaction cross section near the threshold for Y* formation is obtained. The spin and parity of Y* can be determined by comparing the results with experimental data. (auth)

18732 AN INTEGRAL EQUATION FOR THE $\omega_0 \to 3\pi$ DECAY. V. A. Shakhbazyan. Zh. Eksperim. i Teor. Fiz., 46: 196-200(Jan. 1964). (In Russian)

A deduction and investigation of the approximate integral equation for the absorption part of the $\overline{\omega_0} \to 3\pi$-decay amplitude are presented. (auth)

18733 THRESHOLD ANOMALIES IN THE PHOTOPRODUCTION OF π MESONS ON NUCLEONS. M. P. Rekalo (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 46: 218-22(Jan. 1964). (In Russian)

Threshold anomalies in π^0-photoproduction due to the η-meson are considered. The shape of the anomalies in π^0-production can be predicted if the anomalous energy dependence of the π^+-photoproduction cross section is ascribed to the η-meson. The shape of the anomalies significantly depends on the quantum numbers of the η-meson. (auth)

18734 ON THE POSSIBLE SCHEME OF PRODUCTION OF Λ HYPERONS VIA ISOBARS IN π^- p INTERACTION AT 7-8 Bev ENERGY. V. F. Vishnevskii, Yuan-tsai Tu, W. T. Moroz, A. V. Nikitin, Yu. A. Troyan, Shao-chun Chiang, Wen-ti Chang, B. A. Shahbazyan, and Wu-Kuang Yen (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 46: 232-42(Jan. 1964). (In Russian)

The groups of Λ-hyperons previously found are satisfactorily explained by assuming that the Λ-hyperons come out as the decay products (via strong interaction) of the isobars (including Y* resonant particles-hyperon isobars), which are formed first in the π^-p interaction. The results of the kinematic analysis seem to agree well with the various representations of the experimental distributions. To fit the experimentally observed intensities of the groups, the relative yields of the decay channels concerned are also estimated. Furthermore in the kinematic analyses some of the isobar decay processes, such as $N_3^* \to \Lambda + K$, were not yet confirmed experimentally, yet they appear physically possible. Considering the small background of the distributions and the effect of the system formed together with the isobar concerned, one is inclined to believe that the majority of the π^-p interactions lead to a two-body reaction, one or both of the secondaries being isobars. (auth)

18735 PHOTOPRODUCTION OF STRANGE PARTICLES AT HIGH ENERGIES. M. P. Rekalo (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 46: 293-9(Jan. 1964). (In Russian)

Photoproduction of strange particles at high energies and K meson formation angles ~180° is considered. Both possible values of the intrinsic parity of the KNY system are discussed. Expressions for asymptotic cross sections and various polarization effects are obtained on the basis of the hypothesis of moving Regge poles in the scattering amplitude. (auth)

18736 RADIATION FROM FAST ELECTRONS WITH ORIENTED SPINS IN A MAGNETIC FIELD. I. M. Ternov, V. G. Bagrov, and R. A. Rzaev (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 46: 374-82(Jan. 1964). (In Russian)

The polarization properties of the radiation from relativistic electrons with spins orientated in a magnetic field are investigated. Two cases of electron spin polarization are considered: polarization along the direction of motion and polarization along the magnetic field strength vector. (auth)

18737 VERIFICATION OF THE PROPERTIES OF THE VAVILOV-CHERENKOV RADIATION IN AN UNIAXIAL CALCITE CRYSTAL. V. P. Zrelov (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 46: 447-56(Feb. 1964). (In Russian)

Experimental results of a study of a number of properties of the Vavilov-Cherenkov radiation in an uniaxial crystal of calcite produced by a 663-Mev proton beam ($\beta = 0.81$) are presented. The radiation properties were investigated in the two particular cases: (a) the particles move along the optical axis and (b) the particles move perpendicular to the optical axis of the crystal. The predictions of the theory that in case (a) a single cone of extraordinary waves is excited and in case (b) two radiation cones are excited (an ordinary and extraordinary one) are confirmed experimentally. The conclusions of the theory regarding the directional properties (emission angles) of the radiation, the polarization and threshold properties, and azimuth distribution of the radiation intensity are also in complete agreement with the theory. (auth)

18738 THE MANDELSTAM REPRESENTATION AND THE CONTINUITY THEOREM. D. Ya. Petrina (Inst. of Mathematics, Academy of Sciences, Ukrainian, SSR). Zh. Eksperim. i Teor. Fiz. 46: 544-54(Feb. 1964). (In Russian)

A method is proposed that permits one to determine at which points of the Landau surface the contributions from Feynman diagrams are holomorphic functions. The Mandelstam representation is proven for the envelope diagram, Kim diagram, and tetrahedrals or opened envelope diagram. (auth)

18739 BEHAVIOR OF THE CROSS SECTION FOR THE INELASTIC PROCESS a + b $\to$ c + d + e AT HIGH ENERGIES. I. G. Ivanter, A. M. Popova, K. A. Ter-Martirosyan. Zh. Eksperim. i Teor. Fiz., 46: 568-77 (Feb. 1964). (In Russian)

The asymptotic expression for the amplitude for transformation of two particles into three particles at high energies, derived previously on the basis of the one-pole Regge approximation is employed for calculation of the total cross section of the reaction and for determination of the most probable values of the momenta of the resulting particles. It is shown that in the high energy region where $s = s_{ab} \to \infty$, the total cross section for the reaction a + b $\to$ c + d + e depends on energy according to the formula $\{c_1 \ln [\ln (s/m^2)] + c_2 s\}/\ln (s/m^2)$. An investigation of the differential cross section for the reaction a + b $\to$ c + d + e showed that the most probable are those cases when all three resulting particles are ultrarelativistic, two of them moving in the c.m.s. of the reaction in a narrow cone in one direction and the third in the other direction. The larger part of the cross section of the order of $\{\ln [\ln (s/m^2)]\}/\ln (s/m^2)$ corresponds to the case of so-called truly inelastic collisions when all three invariants s_{ce}, s_{cd}, and s_{de} for $s \to \infty$ are large compared with m^2. In this case one of the two particles emitted in a given direction possesses a momentum that considerably exceeds that of the other particle. If the momenta of these particles are the same, their energy in the c.m.s. will be small. This corresponds to the so-called almost elastic collisions; their contribution to the total cross section is of the order of $1/\ln (s/m^2)$. If the energy is not very large, that is, $\ln (s/m^2)$is not much greater than unity, the probability for formation of two fast particles and one slow particle that is almost isotropically distributed with respect to angle in the c.m.s. of the reaction will be relatively large (of the order of $1/\ln^2 (s/m^2)$. (auth)

18740 FLECTROPRODUCTION OF π-MESONS AND FERMION REGGE POLES. M. P. Rekalo (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 46: 612-19(Feb. 1964). (In Russian)

Production of mesons(π) at angles ~180° in the c.m.s. of

the high energy colliding electrons and the nucleons is considered. Longitudinal components of the virtual photon polarization vector do not contribute to the asymptotic quantity under consideration. Asymptotic formulas are derived for the differential cross sections and polarization of the recoil nucleons. The correlation quantities are oscillating functions of energy and angle. (auth)

18741 INTERSECTION OF VACUUM POLE TRAJECTORIES. I. I. Roizen and D. S. Chernavskii (Lebedev Inst. of Physics, Moscow). Zh. Eksperim i Teor. Fiz., 46: 628-36(Feb. 1964). (In Russian)

The possibility of intersection of several vacuum pole trajectories at the point l = 1 for t = 0 is discussed in connection with the problem of taking into account the contribution of many-particle states in the t-channel. The case of interaction of two trajectories is considered in great detail. It is demonstrated that this permits one to explain the experimental data on π^-p and pp scattering and yields a definite relation between the total cross sections of the processes. A simple example is presented for which a nondecreasing asymptotic for the elastic scattering cross section can be obtained within the framework of the Regge method. (auth)

18742 ON A SET OF ALGEBRAIC EQUATIONS EQUIVALENT TO THE LOW EQUATIONS. P. Kh. Byrnev, V. A. Meshcheryakov, and I. P. Nedyalkov (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 46: 663-70(Feb. 1964). (In Russian)

A set of algebraic equations that is equivalent to the Low equations is derived. The set is derived by conformally transforming the physical plane into a circle and expanding the scattering amplitude into a power series. The algebraic equation set expresses such relations between the series coefficients that ensure that the unitarity condition and cross relations are satisfied. (auth)

18743 THE $\pi^+ + p \rightarrow \pi + \pi + N$ REACTION NEAR THE THRESHOLD. Yu. Niri (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 46: 671-2(Feb. 1964). (In Russian)

Reactions in which two mesons(π) are produced as a result of π^+ collision near the threshold are considered. The differential cross sections of the reactions are obtained with an accuracy to terms of the third order with respect to the relative momenta of the produced particles. (auth)

18744 INELASTIC SCATTERING OF PHOTONS BY A COULOMB FIELD ACCOMPANIED BY ELECTRON-POSITRON PAIR PRODUCTION. G. M. Shklyarevskii (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 46: 690-4(Feb. 1964). (In Russian)

Inelastic photon scattering on a Coulomb field involving electron-positron pair production is analyzed by means of the Weizsacker-Williams method. It is found that scattering into small angles is much greater than the correction to the Compton effect on protons due to the proton polarizability. (auth)

18745 QUANTUM PROCESSES IN THE FIELD OF A PLANE ELECTROMAGNETIC WAVE AND IN A CONSTANT FIELD. [PART] I. A. I. Nikishov and V. I. Ritus (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 46: 776-96(Feb. 1964). (In Russian)

The effect of the field of a plane electromagnetic wave of a constant electromagnetic field on various quantum phenomena is investigated. General formulas are derived for the probabilities for radiation of a photon by an electron, for pair production by photons, and for single photon annihilation of an electron and positron in the field of a plane electromagnetic wave. For $ea/m \ll 1$ (a_μ is the potential amplitude) these formulas transform into the corresponding probabilities of perturbation theory and for $ea/m \gg 1$ they transform into the probabilities for processes in crossed field ($EH = 0$, $E^2 - H^2 = 0$) with a field strength E sin ψ averaged over the phase ψ. The exact formulas for the probabilities of processes in a crossed field depend on the invariant $\chi = e\sqrt{(F_{\mu\nu}p_\nu)^2}/m^3$ where p_ν is the particle momentum; they are applicable to an arbitrary constant field $F_{\mu\nu}$ provided $(F_{\mu\nu}p_\nu)^2/m^2 \gg F_{\mu\nu}^2$, $i\epsilon_{\mu\nu\lambda\sigma}F_{\mu\nu}F_{\lambda\sigma}$, and the latter are much smaller than $(m^2/e)^2 = (1.3 \cdot 10^{13}$ abs. Heavyside units$)^2$. (auth)

18746 RADIATION AND OPTICS. AN INTRODUCTION TO THE CLASSICAL THEORY. John M. Stone. New York, McGraw-Hill Book Company, Inc., 1963. 557p.

The behavior of electromagnetic radiation is considered. The topics discussed include vector analysis, sinusoidal oscillations and waves and their complex representation, the microscopic description of matter and the microscopic Maxwell equations, energy and energy flow in the electromagnetic field, monochromatic dipole radiation, diffraction, Fraunhofer diffraction by N identical apertures, treatment of diffraction in the scalar approximation, application of the Kirchkoff integral to Fraunhofer and Fresnel diffraction, Fourier analysis and applications to optical problems, radiation from Lorentz atoms, polychromatic waves, scattering, macroscopic Maxwell theory, reflection and transmission, double refraction, magneto-optics and electro-optics, and the relation of quantum to classical theory. (C.E.S.)

18747 ELEMENTARY PARTICLES. David H. Frisch and Alan M. Thorndike. Van Nostrand Momentum Books. Princeton, N. J., D. Van Nostrand Company, Inc., 1964. 160p.

The concept of elementary particles and the members of the classification are discussed. The detection and measurement of properties and reactions of elementary particles are considered. The discovery of the antiproton, forces between elementary particles, and conservation laws and invariance principles are discussed. (R.E.U.)

18748 METHOD AND APPARATUS FOR PRODUCING AND ANALYZING POLARIZED GAMMA RADIATION. Morton Hamermesh, Stanley S. Hanna, and Gilbert J. Perlow (to U. S. Atomic Energy Commission). U. S. Patent 3,130,315. Apr. 21, 1964.

A method of polarizing and resolving the plane of polarization of gamma rays is described. Polarization is produced by positioning a thin disc of ferromagnetic metal, containing ^{57}Co, in a magnetic field. Resolution is accomplished by rotating a thin disc of iron enriched in ^{57}Fe relative to a second magnetic field and noting the change of gamma absorption at each rotational position. (AEC)

Field Theory and Quantum Mechanics

18749 INTERNAL STRUCTURE OF PHYSICAL FIELDS. J. I. Horvath (Jozsef Attila Univ., Szeged). Acta Univ. Szeged., Acta Phys. Chem., 9: 3-24(1963).

The handedness, i.e., the right and left asymmetry of elementary particles is explained in terms of the relativistic phase-space formalism. In this way a new development of the previous theory is suggested. The field equations are derived by variational method, the mass spectrum of baryons are obtained and Noether's theorem is generalized. In fact, the transformations, defined usually in the isobaric spin space, appear as continuous transformations. The

philosophical concept of space-time continuum as well as the interpretation of the method suggested is discussed. (auth)

18750 REMARKS ON A COORDINATE TRANSFORMATION TO AN ACCELERATED FRAME OF REFERENCE. Jacques E. Romain (General Dynamics, Fort Worth, Tex.). Am J. Phys., 32: 279-85(Apr. 1964).

A coordinate transformation from a one-dimensional inertial frame of reference to an accelerated one in empty space-time was recently proposed by Lass. His derivation displays the remarkable feature that the motion of the accelerated frame relative to the inertial frame is fully determined by a set of assumptions, none of which implies any requirement regarding the individual motions of the different points of one frame relative to the other frame. This peculiarity is ascribed to the conjunction of several independent constraints imposed on the mutual relative motions of such points among themselves. The properties involved in Lass' transformation are analyzed, and their mutual implications are studied. It is found that one property (namely, that the speed of light with respect to the noninertial frame, at each point of this frame and in both directions, is time-independent) has a special status. A comment is made regarding the extension of the transformation to a three-dimensional system. (auth)

18751 A WEYL CORRESPONDENCE FOR ANGULAR MOMENTUM. D. Kleima (State Univ., Groningen, Holland). Ann. Phys. (N. Y.), 27: 58-71(Mar. 1964).

The Weyl correspondence between quantum mechanical observables and quasi-classical functions of the coordinates and momenta was extended to angular momentum operators. Whether this correspondence can be used for the definition of external and internal coordinates and momenta in a system of two (or more) angular momenta, is discussed. External, internal, and collective coordinates are discussed. (auth)

18752 A UNIFYING PRINCIPLE OF INTERACTIONS? K. E. Eriksson (Uppsala Univ.). Arkiv Fysik, 25: 175-80 (1964).

A unifying principle for all interactions is suggested with Coulomb's law as a model. If this principle is correct, the problem of finding the fundamental interactions is reduced to the problem of finding the sources of interaction. The principle states that the sources of interaction are real conserved quantities. Einstein's theory of gravitation and the theory of electrodynamics follow from the principle if the energy momentum density and the electric current density (multiplied by suitable constants) are recognized as sources of interaction. The fundamentals of a theory for a massless spin-$\frac{1}{2}$ particle in interaction with the gravitational and electromagnetic fields are outlined. (auth)

18753 ON CUTOFFS IN QUANTUM MECHANICS. Jacques Mandelbrojt and Szolem Mandelbrojt. Compt. Rend., 258: 1173-6(Jan. 27, 1964). (In French)

The procedure used to obtain numerical results is analyzed. An inequality between the half-interval and normalization constant associated with a particular cutoff is established. (D.C.W.)

18754 GRAVITATIONAL COLLAPSE. J. V. Narlikar (Univ. of Cambridge, Eng.). Discovery, 25: No. 3, 18-22 (Mar. 1964).

The question on the origin and nature of strong radio waves leads to the hypothesis that gravitational energy is converted into radio waves by gravitational collapse of super-stars. Space-time singularity is discussed in terms of Newtonian theory of gravitation and General Theory of Relativity. It is postulated that space-time singularity can be avoided by a negative energy field which grows stronger than gravitation as the object begins to contract. A cosmological analogy of the negative energy field is made with the Steady State Theory of the Universe. (L.B.S.)

18755 PROPERTIES OF THE SOLUTION TO THE BETHE-SALPETER EQUATION IN THE ANGULAR MOMENTUM PLANE. P. Suranyi (Joint Inst. for Nuclear Research, Dubna, USSR). Dokl. Akad. Nauk SSSR, 154: 317-20(Jan. 11, 1964). (In Russian)

Solutions of the BS equations in the ladder approximation of the theory of $\lambda\phi^4$ interactions (Case I) and vector exchange interactions (Case II) for scalar mesons are discussed for non-zero values of the particle mass m and the total energy of the interaction $\sqrt{s}$. It is shown that the kernel of the BS equation V_l satisfies the inequality $\bar{V}_l > V_l > 0$ for $|s| < 4m^2$ (Case I), and $s > -\mu^2$, $2m^2 > s > -4m^2$ (Case II). Here $\bar{V}_l$ is the asymtotic solution to the BS equations ($s = m = 0$). Then iterative solutions for the scattering amplitude T_l will not have any singularities for $Re_l > l_0$ ($dV_l/dl < 0$). (TTT)

18756 ON THE CALCULATION OF CLEBSCH-GORDAN COEFFICIENTS. K. Zakauskas, R. Karazija, A. Bandzaitis, and A. Jucys (Inst. of Physics and Mathematics, Academy of Sciences, Lithuanian SSR and Kapsukas State Univ., Vilnius, USSR). Lietuvos Fiz. Rinkinys, 3: 377-88(1963). (In Russian)

The expression of the Wigner coefficient (the symmetrical part of the Clebsch-Gordan coefficient) in terms of Regge nine parameters is transformed for the 6j-coefficient. The formulas of the Wigner coefficients for the values 9/2 and 5 of j_2 are given. For calculation on a digital computer, the Wigner coefficient form is changed and the corresponding program for the computer is characterized. (auth)

18757 THE CLEBSCH-GORDAN COEFFICIENTS OF THE GROUP D'_4. M. Balevicius, C. Radvilavicius, and A. Bolotin. Lietuvos Fiz. Rinkinys, 3: 389-412(1963). (In Russian)

The theory of obtaining Clebsch-Gordan coefficients is considered on the basis of the Racah lemma. Clebsch-Gordan coefficients for the group D'_4 are obtained on the basis of the main formulas and corresponding coefficients of the group O'. (auth)

18758 EXPLORER XII OBSERVATIONS OF MAGNETIC SUDDEN IMPULSES IN THE EARTH'S MAGNETOSPHERE. Atsuhiro Nishida (Univ. of Chicago) and J. H. Young. Nature, 201: 1113-14(Mar. 14, 1964).

The operation of the flux-gate magnetometer on board Explorer XII (launched on Aug. 16, 1961) made possible the undertaking of a correlation investigation of geomagnetic field observations of ground-based magnetometers with the satellite observations at (geocentric) altitudes ranging from about three to thirteen Earth radii (R_E). Two examples of Explorer XII magnetic records around the times of world-wide sudden impulses on the ground are presented. Satellite data (points) are discussed. A positive sudden impulse (a sudden, world-wide increase in the geomagnetic field intensity) was attributed to a compression of the magnetosphere, supposed to be due to an intensification of the solar wind. A negative sudden impulse, which was observed about half as often as an increase, is similarly explained by an expansion of the magnetosphere that results from a diminution in the solar wind intensity. (P.C.H.)

18759 FERMION SELF-MASSES AND LEHMANN'S SPECTRAL REPRESENTATION. G. Pócsik (Roland Eötvös Univ., Budapest). Nucl. Phys., 49: 286-8(Nov. 1963).

Lehmann's theorem is extended to the case of the spinor

self-coupling. In a simplified version of the new theorem the usual self-consistent mass equation holds. (auth)

18760 HERMITICITY OF HAMILTONIANS AND EXISTENCE OF EIGENSTATES IN SOLUBLE FIELD THEORIES. Walter C. Henneberger (Dublin Inst. for Advanced Studies). Nucl. Phys., 49: 321-7(Nov. 1963).

The model in which a charged, elastically bound point electron interacts with the dipole part of the radiation field is studied within the framework of the new Tamm-Dancoff method. It is shown that assumption of the existence of eigenstates forces the conclusion that the Hamiltonian is not hermitian. Since this behavior is shared by the Lee model when the coupling constant exceeds the critical value, the difficulties of the two models may well have a common origin. It is shown that, if imaginary values for energy differences are disregarded, the N.T.D. method gives the same energy shifts and phase shifts as the method of transformation to normal coordinates. (auth)

18761 APPLICATION OF FUNCTIONAL METHODS IN QUANTUM FIELD THEORY AND QUANTUM STATISTICS. I. DIVERGENCE-FREE FIELD THEORY WITH LOCAL NON-LINEAR INTERACTION. E. S. Fradkin (Lebedev Inst. of Physics, Moscow). Nucl. Phys., 49: 624-40(Dec. 1963).

Using the functional solution for the S matrix within specified approximations it is shown that there are divergence-free theories with local nonlinear lagrangian. (auth)

18762 PARTICULAR CASE OF THE THREE-BODY PROBLEM. A. I. Baz (Kurchatov Inst. of Atomic Energy, Moscow). Nucl. Phys., 51: 145-54(Feb. 1964).

The problem of two interacting particles in an external field is considered. The interaction between the two particles is assumed to be large but of vanishing range. It is shown that in this case the six-dimensional Schroedinger equation can be reduced to a one-dimensional integral equation of the Fredholm type. (auth)

18763 RELATIVISTIC QUANTIZATION OF FIELDS. Yasushi Takahashi (Dublin Inst. for Advanced Studies) and Hiroomi Umezawa. Nucl. Phys., 51: 193-211(Feb. 1964).

Relativistic free fields are quantized without recourse to the Lagrange formalism. Conservation laws are derived directly from equations of motion. The method proves useful in the discussion of asymptotic fields. The interaction of fields is also discussed. (auth)

18764 LEGENDRE TRANSFORMS OF SCATTERING AMPLITUDES AND A CROSSING-SYMMETRIC REPRESENTATION. R. J. Eden (CERN, Geneva). Nuovo Cimento (10), 31: 998-1012(Mar. 1, 1964).

Legendre transforms differ from partial-wave amplitudes by the use of variables of integration that are more appropriate for crossing symmetry. It is shown that their holomorphy properties are similar to those of partial-wave amplitudes. Using Legendre transforms the Watson-Sommerfeld transformation can be applied in a crossing-symmetric form, and the asymptotic terms can be separated from the background integral in all three energy channels simultaneously. The background integral can be expressed with an exponential factor that decreases it the contour can be moved to the left in the complex l-plane. The background integral satisfies the Mandelstam representation without subtractions, and each asymptotic term has the corresponding cut-plane analyticity with correct thresholds. (auth)

18765 SINGULARITIES OF PARTIAL-WAVE AMPLITUDES ARISING FROM THE THIRD DOUBLE-SPECTRAL FUNCTION. C. E. Jones and V. L. Teplitz (Univ. of California, Berkeley). Nuovo Cimento (10), 31: 1079-85 (Mar. 1, 1964). (UCRL-10989)

The partial-wave amplitudes are shown to have singularities along the left-hand cut, for both integral and nonintegral angular momenta, at positions where there are peaks in the third double-spectral function. The nature of these singularities and their connection with the Gribov-Pomeranchuk essential singularities in the angular momentum plane are discussed. (auth)

18766 MULTIPERIPHERAL SCATTERING AND SINGULAR BETHE-SALPETER EQUATIONS. G. Cosenza (Scuola di Perfezionamento in Fisica Nucleare, Rome), L. Sertorio, and M. Toller. Nuovo Cimento (10), 31: 1086-1100(Mar. 1, 1964).

The asymptotic absorptive scattering amplitude is investigated, in the framework of the multiperipheral model, for two cases in which the leading singularity is a cut and not a Regge pole. A general method is indicated for finding the positions of the cuts in the partial-wave amplitudes in the complex angular-momentum plane. Relations between the functions representing the discontinuities of the amplitude along the cut and some generalized solutions of the Bethe-Salpeter equation are shown. (auth)

18767 ON THE TRANSFORMATION OF THE SCHRÖDINGER WAVE EQUATION INTO A SYSTEM OF EQUATIONS OF STOCHASTIC PROCESSES WHICH HAVE FIRST AND SECOND MEAN SQUARE DERIVATIVES. K. Koštál (Czech. Tech. Univ., Prague). Phys. Letters, 9: 26-9 (Mar. 15, 1964).

It is shown that the Schroedinger wave equation that describes the motion of a particle in a force field derivable from a potential energy can be transformed in a simple way into a system of differential equations for real stochastic processes that have first and second mean square derivative with respect to time. (C.E.S.)

18768 ON THE ELIMINATION OF DIVERGENCES IN THE QUASIPOTENTIAL EQUATIONS. A. T. Filippov (Joint Inst. for Nuclear Research, Dubna, USSR.). Phys. Letters, 9: 78-80(Mar. 15, 1964).

It is shown how to avoid the divergences that arise in the construction of quasipotential equations in field theory. The discussion is restricted to considerations of a scalar field φ with $\lambda\varphi^3$ or $g\varphi^4$ interaction. (C.E.S.)

18769 NONRENORMALIZABILITY AND THE SHORT-RANGE FORCE IN SOME FIELD THEORETIC MODELS. Raymond F. Sawyer (Univ. of Wisconsin, Madison). Phys. Rev., 134: B448-53(Apr. 27, 1964).

Bethe-Salpeter equations for the scattering Green's functions are discussed in some nonrenormalizable models. The models involve the multiple exchanges of pairs of Dirac particles, coupled to the scattering particles by a four-Fermi interaction. The Green's function is constructed from a Bethe-Salpeter scattering wave function. For certain forms of coupling the forces are repulsive at short distances and analogous to potentials in a nonrelativistic scattering problem that behave as r^{-6} at the origin. In these cases there is a unique, well defined, and Fourier transformable solution for the Green's function in space-time; and the scattering amplitude exists. A class of terms corresponding to delta-function potentials may be included in the interaction kernel without changing the solution. In a case with zero-mass particles and zero total energy an exact solution for the scattering amplitude is obtained. (auth)

18770 TRANSLATIONAL INERTIAL SPIN EFFECT WITH MOVING PARTICLES. O. Costa de Beauregard

(Institut Henri Poincare, Paris). Phys. Rev., 134: B471-5(Apr. 27, 1964).

Although the final conclusion of a preceding paper was incorrect the main point remains, and should entail the existence of sui generis recoil effects associated with non-zero values of curl σ (σ is the spin density). These should be observed by testing, not with solids as was previously proposed, but with the probability fluids associated with moving particles; this more refined type of experiment should be able to select, among the set of integrally equivalent energy-momentum tensors, the one describing locally the true or physical energy-momentum flux. It is shown, by an explicit calculation, that cylindrical type solutions of the extreme relativistic Dirac equation exist with no z dependence of the wave function (and thus no k_z component of the momentum) but still with a z component of the Dirac probability current; as this conclusion is reached with a t dependence of the wave function of strictly the form $\exp(-iWt/\hbar)$, there is no question of having to perform a Foldy-Wouthuysen transformation to extract the positive energy contribution (or equivalently, to use the Newton-Wigner position operator). The transverse inertial spin effect is predicted to be locally described by the flux of the Dirac current per time dt and surface ds and corresponds to the local transition probabilities between the dynamical state of the beam and a pointlike localization of the incident particles. (auth)

18771 SIGNAL PROPAGATION IN A POSITIVE DEFINITE RIEMANNIAN SPACE. C. Lanczos (Dublin Inst. for Advanced Studies). Phys. Rev., 134: B476-80(Apr. 27, 1964).

It is commonly accepted that the propagation of signals requires a space that is hyperbolic in time. The indefiniteness of the metric thus established contradicts the natural requirements of a rational metric. The proof is given that a genuinely Riemannian (positive definite) space of fourfold lattice structure is well suited to the propagation of signals, if the g_{ik} assume very large values along some narrow ridge surfaces. The resulting signal propagation is strictly translational and has the nature of a particle that moves with light velocity (photon). According to this theory the discrepancy between classical and quantum phenomena is caused by the misinterpretation of a Riemannian metric in Minkowskian terms. The Minkowskian metric comes about (in high approximation) macroscopically, in dimensions that are large in comparison to the fundamental lattice constant. Since this constant is of the order 10^{-32} cm, this condition is physically always fulfilled. (auth)

18772 GENERALIZATION OF THE BOGULIUBOV METHOD APPLIED TO MIXTURES OF BOSE-EINSTEIN PARTICLES. W. H. Bassichis (Case Inst. of Tech., Cleveland). Phys. Rev., 134: A543-9(May 4, 1964).

The method developed by Boguliubov for an imperfect Bose-Einstein gas is generalized in order to permit examination of a mixture of an arbitrary number of different species of bosons. The generalized method involves diagonalization of a matrix that has a Hermitian-like property by a unitary-like transformation in a space with an indefinite metric. When a neutral mixture of two types of charged bosons is examined, it is found that two types of elementary excitations exist; one having the energy-momentum dispersion relation associated with plasma oscillations at low momenta and another having the energy-momentum relation characteristic of a free particle with a modified mass at very low and high momenta. Further investigation shows that the plasma-type excitation consists of an oscillation in charge density while the free-particle-like excitation consists of an oscillation in mass density. (auth)

18773 SOLUTION OF THE CLASSICAL ELECTROMAGNETIC SELF-ENERGY PROBLEM. F. Rohrlich (Syracuse Univ., N. Y.). Phys. Rev. Letters, 12: 375-7 (Mar. 30, 1964).

A formulation of the classical theory of point charges, which is free of divergent expressions, cutoffs, and mass renormalization, is proposed. The theory is based on the assumptions that an action energy exists which is invariant under the full Lorentz group including inversions, and that asymptotically, for $\tau \to \pm\infty$ the particles are free and in uniform motion. The solution to this problem is obtained by considering that the field strength tensor of the total field consists of two parts, a "free" and a "bound" field. (L.B.S.)

18774 POSSIBLE LINK BETWEEN ISOSPACE AND THE GEOMETRY OF SPACE-TIME. Richard P. Treat (Univ. of California, Los Angeles). Phys. Rev. Letters, 12: 407-8(Apr. 6, 1964).

A relation between internal degrees of freedom and event space in quantum field theory is suggested. The event space is considered as a Riemann space in accord with general relativity. The dimension, metric, linear connection, and curvature tensor of the internal space are uniquely determined by the Riemann geometry. (L.B.S.)

18775 A GENERATING FUNCTION METHOD FOR ELIMINATING ANOMALOUS DIAGRAMS IN STATISTICAL MECHANICS. R. Balian and C. de Dominicis (Centre d'Etudes Nucléaires, Saclay, France). Physica, 30: 293-302(Feb. 1964).

A new derivation is given for the expansion of the Gibbs potential and thermal Green's function in terms of the true occupation numbers. In this derivation, the so-called anomalous diagrams are eliminated directly with the aid of a generating function. This procedure casts into evidence the reason for the formal resemblance of the results with the zero-temperature expansions. The analogy between this method and the proof of the Hugenholtz-Van Hove theorem is stressed. (auth)

18776 EXACT SOLUTION OF A RELATIVISTIC FIELD THEORY. T. Pradhan (Ravenshaw Coll., Cuttack, India). Proc. Natl. Inst. Sci. India, Pt. A, 28: 249-60(Mar. 26, 1962).

A relativistic quantum field theory with a derivative coupling between a Fermi field of spin $\frac{1}{2}$ and a neutral Bose field of spin zero is solved exactly in four dimensions and is shown to be renormalizable. Renormalized matrix elements of Heisenberg field operators and elements of S matrix for boson-fermion collision are explicitly computed. An outline is given of the method of application of the results of the theory to the problem of renormalizability of vector-meson interactions, which are supposed to mediate weak interactions in the V–A theory. (auth)

18777 EXAMPLE OF A DIFFERENTIAL EQUATION POSSESSING LOWER SYMMETRY THAN ITS SOLUTION. Vachaspati (Univ. of Lucknow, India). Proc. Natl. Inst. Sci. India, Pt. A, 28: 282-5(Mar. 26, 1962).

An example is given in which the differential equations are not invariant under certain co-ordinate transformations while their solutions are. Invariance of these equations under infinitesimal relativistic conformal transformations is investigated. (auth)

18778 VECTOR TETRADS AND EQUATIONS OF GEODESICS. K. P. Singh and M. P. Verma (Banaras Hindu Univ., India). Proc. Natl. Inst. Sci. India, Pt. A, 28: 293-300(Mar. 26, 1962).

The equations of geodesics in a relativistic gravitational field have been expressed in a vector tetrad space. The properties of a tensor $L_{\nu\alpha\sigma}$ that appears in these equations and those of a vector C_μ obtained by contracting the tensor $L_{\nu\alpha\sigma}$ have been examined. It is found that C_μ is associated with the Newtonian force to the first approximation for certain well-known line elements of physical significance. (auth)

18779 THE STABILITY OF A GRAVITATING CYLINDER IN THE PRESENCE OF MAGNETIC FIELDS. J. M. Gandhi (Government Coll., Bhilwara, Rajasthan, India). Proc. Natl. Inst. Sci. India, Pt. A, 28: 317-24(Mar. 26, 1962).

We study the stability of an infinitely long gravitating cylinder of incompressible, inviscid, and infinitely conducting fluid in the presence of an axial magnetic field varying as $H_z \sim (R_0^2 - r^2)^n$, n being a positive integer or half of it or zero. The field satisfies the conditions for "true equilibrium" for all such n's except when n = 0. The field has a stabilizing effect on the cylinder for n = 0, $\frac{1}{2}$, 1, $\frac{3}{2}$, and 2, the values considered in this paper, and it has been shown that the value of the root mean square magnetic field within the cylinder slowly increases with increasing values of n. (auth)

18780 SHOCK WAVES IN AN ULTRA-RELATIVISTIC FLUID. T. P. Mitchell (Cornell Univ., Ithaca, N. Y.) and D. L. Pope. Proc. Roy. Soc. (London), Ser. A, 277: 24-31 (Jan. 7, 1964).

The special theory of relativity is used to analyze the motion of plane shock waves in a medium whose equation of state is $\mu = 3p$, μ being the mass density and p the pressure. The appropriate conservation equations together with this pressure-density relation provide a determinate set of equations for obtaining the downstream, in terms of the upstream, variables. The properties of normal and oblique shock waves in this gas are studied in the Lorentz frames in which the shocks are at rest. (auth)

18781 INFINITE TIME FORMALISM IN QUANTUM FIELD THEORY. Yu. D. Usachev (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 46: 187-95 (Jan. 1964). (In Russian)

A new variant of the infinite time formalism (i. t. f.) is proposed in which all three representations, including the Schroedinger, are formulated. Their complete equivalence is demonstrated. In the given i. t. f. there is no double time dependence of the quantized field operators. Equations of motion for the field operators in the i. t. f. are derived. The relation to the usual S-matrix is discussed. (auth)

18782 OSCILLATION OF PHOTON DENSITY IN A RESONANCE MEDIUM. A. I. Alekse'ev, Yu. A. Vdovin, and V. M. Galitskii (Moscow Inst. of Engineering Physics). Zh. Eksperim. i Teor. Fiz., 46: 320-30(Jan. 1964). (In Russian)

Oscillations of the photon density in a finite size resonance medium are treated by quantum electrodynamics methods for the case when photon losses can be neglected. The oscillation period and maximum photon density are determined and the effect of narrowing of spectral lines with increasing photon density is explained. A comparison with the experimental data is carried out. (auth)

18783 ON THE QUANTUM THEORY OF TRANSFER PHENOMENA IN STRONG MAGNETIC FIELDS. P. S. Zyryanov and V. P. Silin (Inst. of Metal Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 46: 537-43(Feb. 1964). (In Russian)

Noncollisional particle and thermal flow in an electron system due to temperature and chemical potential gradients orthogonal to the quantized magnetic field are calculated. (auth)

18784 NEW REDUCTION FORMULAS. Yu. M. Shirokov (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 46: 583-92(Feb. 1964). (In Russian)

The method for establishing the relation between matrix elements of local operators and experimentally observed quantities developed previously is generalized and strengthened in several directions. It is shown that the method is not only applicable to the energy-momentum tensor and electromagnetic current but also to any other local quantity. Secondly, the set of equations that establishes this relation is considerably expanded. Thirdly, it is shown that the well known Lehmann–Zimmermann–Symanzik reduction formula can also be derived on the basis of the dynamical momenta method and is a special case of it. (auth)

18785 ELEMENTARY AND COMPOUND PARTICLES IN THE LAGRANGIAN FORMALISM. M. A. Braun (Leningrad State Univ.). Zh. Eksperim. i Teor. Fiz., 46: 677-85 (Feb. 1964). (In Russian)

It is investigated to what extent a compound particle can be described by an independent field. The field introduced for describing the compound particle is assumed to possess a mass M that differs from that of the compound particle M_0. The theory is considered for $M \to M_0$. In the limiting case the particle Green function and renormalized constants become meaningless and the amplitudes on the mass surface change over to the amplitudes in the compound particle theory (without an independent field). (auth)

18786 ON THE INTERACTION OF A QUANTUM SYSTEM WITH A STRONG FIELD. T. A. Germogenova and S. G. Rautian (Inst. of Mathematics, Academy of Sciences, USSR and Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 46: 745-54(Feb. 1964). (In Russian)

An approximate method is developed for solving the equations describing the interaction between a quantum system and a strong field. The description of the system with aid of probability amplitudes and a density matrix is considered. The solution obtained is applied to an electromagnetic field and the specificity of the saturation effect is elucidated for the case when the difference between the spontaneous damping probabilities of the combining levels is large. The stability of monochromatic generation in solid body quantum generators is discussed. (auth)

Geophysics

18787 (AFCRL-63-440) ELECTRON DENSITY PROFILES OF WAVEMOTIONS IN THE IONOSPHERE CAUSED BY NUCLEAR DETONATIONS. George J. Gassmann (Air Force Cambridge Research Labs., Laurence G. Hanscom Field, Bedford, Mass.). Apr. 1963. 25p. (N63-18018)

It is shown that an electron density cross section in the vertical plane through an ionospheric wave can be constructed from a single station's ionospheric recordings if the data are taken at time intervals ≤5 min and the general direction of travel is known. The analysis also yields an approximate value for the velocity. Observations at great distances from detonations at Bikini Atoll and Novaya Zemlya are treated as examples. (auth)

18788 (RM-4037-PR) A NOTE ON PERSISTING RADIO PROPAGATION EFFECTS AFTER HIGH-ALTITUDE NUCLEAR BURSTS. C. M. Crain (RAND Corp., Santa Monica, Calif.). Mar. 1964. Contract AF49(638)-700. 11p.

A general, semiquantitative theoretical explanation for the observed effects of high-altitude nuclear explosions on radio propagation, particularly in the LF and VLF regions, is presented. (D.C.W.)

18789 MICROSEISMS AND AN ATTEMPTED APPLICATION TO EXPLORATION. M. Nafi Toksoez (California Inst. of Tech., Pasadena). Geophysics, 29: 154-77(Apr. 1964).

A study of microseisms is made to determine some of their statistical properties and to investigate the feasibility of their use in determining the structures in the upper several kilometers of the earth's crust by the phase-velocity method. It is found that the microseisms in the period range of 1 to 6 sec arrive from several directions with comparable strength and at the same time. There are occasional short intervals of 10 to 40 sec during which microseisms are mostly unidirectional. It is also found that these relatively short-period microseisms are not stationary in the wide sense over time intervals longer than 5 or 10 minutes. The phase velocities of microseisms recorded with an array of eight instruments are measured in four different locations. The velocities, although scattered, are found to be in agreement with the computed theoretical dispersion curve for the fundamental Rayleigh mode, based on the available seismic velocity information. An error analysis is made, and the confidence limits are placed within ±20 percent of the measured velocities. It is concluded that in determining shallow crustal structures the microseism-phase-velocity method potentially is at least as effective as the gravity method, although it is not as suitable for routine work as the gravity method. (auth)

18790 SEISMIC PROPAGATION PATHS, REGIONAL TRAVELTIMES, AND CRUSTAL STRUCTURE IN THE WESTERN UNITED STATES. David J. Stuart, John C. Roller, Wayne H. Jackson, and George B. Mangan (Geological Survey, Denver). Geophysics, 29: 178-87(Apr. 1964).

A network of about two thousand long-offset refraction seismograms were recorded to provide information on the detection, location, and identification of seismic events. The measured velocities of compressional waves in upper-mantle rocks, P_n, varies from at least 7.75 to 8.25 km/sec in the western United States. There seems to be a systematic variation of the velocity of P_n with geologic environment and also with crustal thickness. Where the crust is thick (>35 km), measured values of the velocity of P_n tend to be high (>8 km/sec), and, where the crust is thin (<35 km), measured values of the velocity of P_n tend to be low (<8 km/sec). The velocity of P_n is generally low in the high mountains of the far west and generally high in the stable continental interior. The close relation between rock density and seismic velocity implies that, on a regional scale, a large part of isostatic compensation is achieved by density variations in upper-mantle rocks. (auth)

18791 OPERATIONAL MAGNIFICATION AND PHYSICAL ENVIRONMENT OF SEISMOGRAPH STATIONS. S. A. Alsup and J. W. Guyton (Geotechnical Corp., Garland, Tex.). Geophysics, 29: 188-96(Apr. 1964).

Maximum satisfactory operational magnifications of 115 standardized seismograph stations in the United States range from 30,000 to 630,000 and are used to evaluate the sites relative to one another. Grouping the sites according to physiographic province, rock type, distance from cultural features, and type of installation shows distinct correlation between physical environment and operating magnification. As composites of the sites studied, the highest magnification site is a mine in an igneous intrusive body in the Basin-Range province; the lowest magnification site is a surface installation on poorly consolidated sedimentary rock on the Coastal Plain. Regional variations of magnification capability are closely related to physiographic provinces; local variation within a province is as great as the variation of physical environment. (auth)

18792 DETECTION OF P-WAVES FROM WEAK SOURCES AT GREAT DISTANCES. Jon F. Claerbout (United Electro Dynamics, Inc., Alexandria, Va.). Geophysics, 29: 197-211(Apr. 1964).

Optimum (Wiener sense) filters for suppression of noise in multiple time series are computed by a new method due to E. A. Robinson. Filters for prediction error and interpolation error were used to detect P-wave signals from three teleseismic events. These filters facilitate detection of signals in noise with low signal-to-noise ratios. The instrumentation consists of short-period Benioff seismometers, both three-component stations and surface arrays of verticals. It was found that microseismic noise in the pass band of these instruments is more accurately termed Brownian motion of a surface than random waveforms with characteristic direction(s) of propagation. Thus, single time-series filters work almost as well as multiple time-series matrix filters. Prediction-error filters gave results substantially more satisfactory than simple band-pass filters. (auth)

18793 A MOVING-TIME-WINDOW SIGNAL-SPECTRA PROCESS. Arthur McGarr, Renner B. Hofmann, and George D. Hair (Texas Instruments, Inc., Dallas). Geophysics, 29: 212-20(Apr. 1964).

Spectra of signals of short time duration may be obtained from either long or short samples. Long samples result in more accurate power-density spectra, but most of the spectrum power will be contributed by noise. Spectra from short samples are significantly altered by truncation effects. A process is described that makes use of the advantages of both methods. Truncation effects are reduced by hanning in the frequency domain. The average spectrum of noise immediately preceding the signal is subtracted from all spectra. A moving-window process allows investigation of signal spectra as a function of time. Examples of the same earthquake signal recorded on several types of instruments illustrate the broad, total spectral content of P waves. (auth)

18794 PROPAGATION OF A PULSE IN A FLUID SPHERE. Z. Alterman and P. Kornfeld (Weizmann Inst., Rehovoth, Israel). Geophysics, 29: 259-87(Apr. 1964).

The exact solution obtained previously for the motion of a uniform compressible fluid sphere due to a pressure pulse from a point source situated below the surface is applied to a source at a distance of one-eighth of the radius below the surface. Taking the sphere as a simplified model of the earth, this corresponds to a source at a depth of about 800 km, which is not far from the depth of a deep-focus earthquake. The time variation of pressure due to the source is represented by the difference between two step functions with rounded shoulders. The surface velocity due to sources of different durations was evaluated for eight angular distances. The solution exhibits step function type and logarithmic reflected pulses, which one would anticipate from the steepest descents analysis of Jeffreys and Lapwood. In addition, the solution reveals single diffracted pulses and groups of diffracted pulses that have no counterpart in ray theory. When geometrical optics allows a ray to appear only after a minimum range θ_0 from the epicenter, the complete wave-theoretical solution shows that these pulses show up earlier in the forbidden zones. Similarly,

in the case where the geometrical optics predicts that a certain ray should appear only for ranges $\theta < \theta_0$, and should not appear for $\theta > \theta_0$, the wave-theoretic solution shows that such a ray does appear, by diffraction, for some range of $\theta > \theta_0$. Arrival times of the diffracted pulses of the first group increase with increasing θ, while for the second group they decrease with θ. (auth)

18795 PULSATING AURORAE AND INFRASONIC WAVES IN THE POLAR ATMOSPHERE. Kaichi Maeda (Goddard Space Flight Center, Greenbelt, Md.) and Tomiya Watanabe. J. Atmospheric Sci., 21: 15-29(Jan. 1964).

Pulsating auroras are proposed as a source of the infrasonic pressure waves associated with geomagnetic activity. One of the most plausible mechanisms for generating these long period pressure waves is the periodic heating of the upper air around the 100-km level by auroral bombardment, during pulsating visual auroras. To see the energetic relation between source input and pressure change at sea level, some theoretical calculations are performed with a simple model of auroral distribution in an isothermal atmosphere. At least 100 erg cm^{-2} sec^{-1} of energy flux variation at auroral height is necessary to produce surface pressure amplitudes of the order of 1 dyne cm^{-2} in this model. The intensity of the pressure waves in this model decreases rapidly outside of the region of auroral activity, indicating the importance of sound-ducts in the upper atmosphere for the propagation of these long period sonic waves. (auth)

18796 DEFORMATION OF THE GEOMAGNETIC FIELD BY THE SOLAR WIND. Gilbert D. Mead (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 69: 1181-95(Apr. 1, 1964).

From the three-dimensional numerical solution to the Chapman-Ferraro problem of a steady solar wind perpendicularly incident upon a dipole field, a simple spherical harmonic description of the distorted field is obtained. From this, a three-dimensional picture of the field line configuration within the magnetosphere is given. The field lines are found to be compressed on both the daytime and nighttime sides. The behavior of the field lines on the daylight side changes abruptly as one approaches a critical latitude, which ranges between 80 and 85°, depending on the intensity of the solar wind. Above this latitude, lines originating along the noon meridian pass over the north pole and cross the equator along the midnight meridian. The behavior of conjugate-point phenomena and trapped particles near this critical latitude is discussed. Magnetic changes at the earth's surface due to an increase in the solar wind intensity are calculated. The diurnal variations due to a steady solar wind are also calculated; they are found to be small compared with observed S_q fields. (auth)

18797 PERTURBATION OF THE GEOMAGNETIC FIELD—A SPHERICAL HARMONIC EXPANSION. James E. Midgley (Southwest Center for Advanced Studies, Dallas). J. Geophys. Res., 69: 1197-1200(Apr. 1, 1964).

The spherical harmonic expansion of the perturbation of the geomagnetic field is calculated, using the magnetopause shape and current system determined previously by the moment technique. The expansion coefficients are compared with those determined by another method. (auth)

18798 A MODEL FOR A BROAD DISORDERED TRANSITION BETWEEN THE SOLAR WIND AND THE MAGNETOSPHERE. W. Bernstein, R. W. Fredricks, and F. L. Scarf (TRW Space Technology Labs., Redondo Beach, Calif.). J. Geophys. Res., 69: 1201-10(Apr. 1, 1964).

It was suggested that charge separation electric fields in the Chapman-Ferraro sheath generate currents large enough to trigger the two-steam plasma instability. It is argued that, as the electric field energy saturates, the drift energy is lowered and the electron temperature rises so that the instability is generally not quenched. Instead, it can change form, leading to growing ion waves. The equilibrium state then involves fluctuating electromagnetic fields which allow "fast" plasma diffusion across the main magnetic field. In this case, the exospheric thermal plasma, together with that part of the solar wind plasma that has attained energy equipartition, can form current systems leading to a broad, disordered transition region between the magnetosphere and the solar wind. 28 references. (auth)

18799 OSCILLATION OF THE GEOMAGNETIC FIELD LINES AND ASSOCIATED MAGNETIC PERTURBATIONS AT CONJUGATE POINTS. Masahisa Sugiura (Goddard Space Flight Center, Greenbelt, Md.) and Charles R. Wilson. J. Geophys. Res., 69: 1211-16(Apr. 1, 1964).

By means of an idealized elastic string model, the symmetry relations in the magnetic perturbation at a pair of conjugate points due to oscillation of the lines of force of the geomagnetic field are studied. For oscillations of odd modes the change in H(ΔH) is parallel, and that in the east component (ΔD) is antiparallel, at the conjugate points, whereas for oscillations of even modes ΔH is antiparallel and ΔD is parallel at the conjugate points. Hence, in the former case the polarizations (as viewed downward) at the conjugate points are mirror images of each other with respect to the meridian plane, and in the latter case they are mirror images with respect to the equator. Several examples indicating these symmetry relations are presented. (auth)

18800 SCATTERING OF ENERGETIC TRAPPED ELECTRONS BY VERY-LOW-FREQUENCY WAVES. John M. Cornwall (Aerospace Corp., El Segundo, Calif.). J. Geophys. Res., 69: 1251-8(Apr. 1, 1964).

The role of vlf waves in precipitating fast electrons is studied. It is found that, by Doppler-shifting whistler frequencies (1 to 10 kc/s) up to the local Larmor frequency, a resonant interaction of the type proposed by Dragt and Wentzel (for interaction of protons with hydromagnetic waves) can cause the mirror points of the electrons to move randomly. The conditions for resonance lead to a very characteristic dependence on L of the regions of the magnetosphere where vlf waves can effectively precipitate electrons. In general, one expects to see, in a plot of flux versus L, two peaks separated by a broad minimum, the first peak near $L \simeq 1.2$ and the second near $L \simeq 2$. Such peaks were seen by several experimenters. In certain regions of space it may be that whistlers can dominate the lifetimes of trapped electrons, especially for $L \gtrsim 2$. (auth)

18801 TRAPPED PROTONS AT LOW ALTITUDES IN THE SOUTH ATLANTIC MAGNETIC ANOMALY. Stanley C. Freden and George A. Paulikas (Aerospace Corp., El Segundo, Calif.). J. Geophys. Res., 69: 1259-69(Apr. 1, 1964).

The fluxes of protons from 5 to 20 Mev and 60 to 120 Mev were measured in September and October 1962 at low altitudes over the South Atlantic magnetic anomaly. The ratio of the fluxes in these two energy intervals is essentially independent of B and is independent of L below $L \simeq 1.4$ but changes rapidly for $L > 1.4$. The flux in the 5- to 20-Mev interval indicates that the spectrum turns back up below the local minimum (at $L \gtrsim 1.5$) near 20 Mev. This result is consistent with an increased absorption in the atmosphere for the albedo neutrons near 20 Mev. The integral flux above 31 Mev appears to have increased by a factor of about 3 at the lower L values and higher B values since the Explorer 4 measurements. This would be expected if the source had stayed essentially constant and the atmospheric

density had decreased in these regions of space as we moved away from the period of solar maximum. (auth)

18802 SATELLITE MEASUREMENTS OF THE DECAY OF THE ARTIFICIAL ELECTRON BELT. E. E. Gaines and R. A. Glass (Lockheed Aircraft Corp., Palo Alto, Calif.). J. Geophys. Res., 69: 1271-5(Apr. 1, 1964).

Measurements of the radiation environment were made with dosimetry films and activation materials flown on a series of low-altitude satellites. In orbits with about 400-km apogee, the electrons injected by the high-altitude nuclear burst of July 9, 1962, increased the average daily radiation dose by a factor of 1000 over the normal 0.01 rad from cosmic rays. The apparent half life for disappearance of the artificial electron belt in the lower regions of the South American anomaly was initially less than 10 days and lengthened to more than 100 days in the first 9 months after the burst. Evidence confirming the identification of the radiation type was provided by depth-dose curves, obtained with Al, Pb, and other absorbers, which were similar to theoretical curves derived for fission electrons. The observation that zenith-side doses were 2 to 5 times greater than earth-side doses is consistent with the expected direction of approach of trapped electrons to the satellite in the region of the South American anomaly. No activation caused by space protons or neutrons was observed in any of the activation materials. (auth)

18803 IONOSPHERIC FOCUSING IN THE PRESENCE OF THE EARTH'S MAGNETIC FIELD. Michael D. Papagiannis and G. Richard Huguenin (Harvard Univ., Cambridge, Mass.). J. Geophys. Res., 69: 1307-18(Apr. 1, 1964).

A new technique was developed for application to problems of radio wave propagation in magnetoionic mediums. This method is based on a mathematical formulation of Poeverlein's graphical solution. The mathematical formulation is made possible by assuming that the index of refraction surfaces are ellipsoids of revolution. Complicated problems can be solved in terms of the semiaxes, a and b, of these ellipsoids, which can be evaluated as continuously varying elements by means of the Appleton-Hartree equation. The results obtained through the application of this method are as exact as that equation. The problem of focusing in the terrestrial ionosphere was investigated in complete generality through an application of this new technique. The general equations obtained have the same structure as those previously derived by neglecting the terrestrial magnetic field. The corresponding radiation patterns are substantially different, however, when the effects of the earth's magnetic field are included. The effects of the earth's magnetic field are very pronounced and cannot be ignored as X approaches unity and Y becomes relatively large. This is the domain of interest to radio astronomy in space. (auth)

18804 TRANSEQUATORIAL RECEPTION OF A VERY-LOW-FREQUENCY TRANSMISSION. C. J. Chilton (National Bureau of Standards, Boulder, Colo), A. H. Diede, and Sandro M. Radicella. J. Geophys. Res., 69: 1319-28 (Apr. 1, 1964).

A comparison is made between the phase and amplitude of the 18-kc signal NBA (Balboa, Panama) recorded at Boulder, Colorado, in the northern hemisphere and Tucumán, Argentina, in the southern hemisphere. Although these two propagation paths are essentially the same length, the difference between them in the diurnal change in phase height is approximately 5 km, and the estimated field strength appears to be significantly lower at Tucumán than at Boulder. It is suggested that the cause of these observed differences is the latitudinal variation in ionization due to cosmic rays. (auth)

18805 SUMMARY OF VISUAL OBSERVATIONS OF THE AURORA FOLLOWING THE NUCLEAR EXPLOSION ABOVE JOHNSTON ISLAND ON 9 JULY 1962. J. F. Gabites and D. S. Rowles. New Zealand J. Geol. Geophys., 5: 920-4(Dec. 1962).

Visual effects observed include an initial flash, the white ray structure, and the red glow of the artificial aurora after the high-altitude nuclear explosion over Johnston Island. (R.E.U.)

18806 OPTICAL OBSERVATIONS FROM WESTERN SAMOA OF THE ARTIFICIAL AURORAL DISPLAY, 9 JULY 1962. J. G. Keyes (New Zealand Dept. of Scientific and Industrial Research, Apia, Western Samoa) and B. A. Tinsley. New Zealand J. Geol. Geophys., 5: 925-32(Dec. 1962).

Photographic observations in color and black-and-white, with spectrographic observations, were made of the 9 July, 1962, artificial aurora from Western Samoa. The position and nature of various features are described, and the white ray extending from above Johnston Island to near Samoa is discussed. (auth)

18807 AIR-GLOW EMISSIONS AND IONOSPHERIC EFFECTS FOLLOWING THE JOHNSTON ISLAND NUCLEAR EXPLOSION ON 9 JULY. S. H. Neff (Univ. of Canterbury, Christchurch, New Zealand), G. A. M. King, and C. H. Cummack. New Zealand J. Geol. Geophys., 5: 933-8(Dec. 1962).

The air glow emissions were associated with an electron cloud in the F region over Christchurch, New Zealand. The cloud seems to have been formed by the influx of exospheric plasma, the air glow emissions being excited by secondary electron impact. Electron recombination provided a part of the observed emission, but this became a major fraction only after about fifteen minutes. (auth)

18808 OPTICAL AND IONOSPHERIC EFFECTS ON THE NUCLEAR EXPLOSION OF 9 JULY 1962. R. S. Unwin, M. Gadsden, C. T. Lewis, and D. S. Rowles (Dominion Physical Lab. Auroral Station, Lauder, Central Otago, New Zealand). New Zealand J. Geol. Geophys., 5: 939-42(Dec. 1962).

Effects observed at the Auroral Station, Central Otago, at Bluff, and at Nandi, Fiji, are reported and briefly discussed. (auth)

18809 MAGNETIC AND EARTH-CURRENT EFFECTS OF THE HIGH-ALTITUDE NUCLEAR EXPLOSION ON 9 JULY 1962. P. J. Gill (Dept. of Scientific and Industrial Research, Christchurch, New Zealand). New Zealand J. Geol. Geophys., 5: 943-53(Dec. 1962).

Magnetic and earth-current effects that followed the high-altitude nuclear explosion above Johnston Island on 9 July, 1962, were recorded at stations operated by New Zealand in Samoa, New Zealand, Campbell Island, and the Antarctic. The disturbance was most intense in the New Zealand region, although earlier explosions produced no magnetic effects there. Small variations were recorded at Scott Base, Antarctica, inside the auroral zone and over 10,000 km from Johnston I. (auth)

18810 EFFECTS AT LOWER HUTT OF THE JULY 1962 HIGH-ALTITUDE NUCLEAR EXPLOSION. A. Hanley (Dept. of Scientific and Industrial Research, Gracefield, Lower Hutt, New Zealand). New Zealand J. Geol. Geophys., 5: 954-9(Dec. 1962).

Magnetic effects of the high-altitude nuclear test of July 1962 were recorded at Lower Hutt, New Zealand. A measurement of the time of detonation based on recordings of received radio signals, and an estimate of the height of the explosion based on a photograph of the fireball were made. (auth)

18811 ONSET TIME AT WELLINGTON OF GEOMAGNETIC MICROPULSATIONS FROM THE JOHNSTON ISLAND HIGH-ALTITUDE NUCLEAR EXPLOSION OF 9 JULY 1962. D. A. Christoffel (Victoria Univ., Wellington, New Zealand). New Zealand J. Geol. Geophys., 5: 960-3 (Dec. 1962).

Recordings obtained at Wellington of the magnetic north-south component of geomagnetic micropulsations originating from the explosion indicate an initial arrival time at 0900:09.6 ± 0.2 UT. Assuming the detonation occurred at 0900:09, this indicates a travel time of 0.6 ± 0.2 sec. It is concluded that the most likely mechanism to produce this first arrival is the injection into the lower exosphere of electrons derived from the decay of neutrons and guided by a line of force terminating near Wellington. (auth)

18812 RIOMETER OBSERVATIONS OF HF NOISE AT SAMOA FOLLOWING HIGH-ALTITUDE NUCLEAR TEST. B. A. Tinsley (Univ. of Canterbury, Christchurch, New Zealand). New Zealand J. Geol. Geophys., 5: 964-8(Dec. 1962).

Long-term enhancement of 42-Mc cosmic noise following the July 9, 1962 high-altitude nuclear test was observed on a riometer in Western Samoa. The enhancement was small, less than 1 db above cosmic background, but remained readable, though decreasing in magnitude, for 10 days after the event. (auth)

18813 LOWER IONOSPHERIC EFFECTS NEAR CHRISTCHURCH FROM THE JOHNSTON ISLAND EXPLOSION OF 9 JULY 1962. J. B. Gregory (Univ. of Canterbury, Christchurch, New Zealand). New Zealand J. Geol. Geophys., 5: 969-71(Dec. 1962).

For a period of about four hours after the Johnston Island explosion of July 9, 1962, the lowest height of detectable ionization decreased from 84 to 77 km at Christchurch. This is attributed to particle influx, probably electrons of intensity 2×10^2 cm^{-2} sec^{-1}, during the period. These incoming electrons are believed to represent the high-energy portion of the larger influx known to have affected the F region over the same period. (auth)

18814 LOWER IONOSPHERIC EFFECTS NEAR THE CONJUGATE POINT OF THE 9 JULY 1962 HIGH-ALTITUDE EXPLOSION. J. B. Gregory (Univ. of Canterbury, Christchurch, New Zealand). New Zealand J. Geol. Geophys., 5: 972-4(Dec. 1962).

For a period of 60 seconds after the explosion above Johnston Island, absorption of 42 Mc radio waves occurred in the conjugate area. The observations can be explained on the basis of ionization by decay electrons from neutrons emitted from the explosion material. An electron concentration of not less than 4×10^4 per cm^2 during the first few seconds after detonation occurred at about 70 km in the conjugate area. (auth)

18815 EFFECTS OF THE JOHNSTON ISLAND EXPLOSION ON LONG-PATH VLF TRANSMISSIONS. G. J. Burtt (Dept. of Scientific and Industrial Research, Lower Hutt, New Zealand). New Zealand J. Geol. Geophys., 5: 978-82(Dec. 1962).

Observations on the transmissions of two very low frequency radio stations with very long paths across the Pacific Ocean showed considerable phase disturbance at the time of the explosion. The results were consistent with a rapid drop of the night-time lower ionosphere from 85 to about 68 km and a steady recovery over a period of about 4 hours. (auth)

18816 SOME EFFECTS OF A HIGH-ALTITUDE NUCLEAR EXPLOSION ON IONOSPHERIC FORWARD SCATTER. J. Mawdsley, W. Ireland, and E. S. Gilfillan (Dept. of Scientific and Industrial Research, Lower Hutt, New Zealand). New Zealand J. Geol. Geophys., 5: 983-7(Dec. 1962).

Observations on a 910-km pulsed ionospheric forward scatter circuit suggest that a complex set of events occurred that gave rise to enhanced ionization with a high degree of irregularity in the scattering region. Both prompt and delayed effects were observed and these are discussed in detail. (auth)

18817 SOME OBSERVATIONS OF MF AND HF RADIO SIGNALS AFTER MID-PACIFIC HIGH-ALTITUDE NUCLEAR EXPLOSIONS. G. C. Andrew (New Zealand Broadcasting Corp., Wellington). New Zealand J. Geol. Geophys., 5: 988-93(Dec. 1962).

Observations on certain medium-frequency transmissions after nuclear explosions show that they were affected by both short-term and long-term ionospheric absorption phenomena. Observations on high-frequency radio stations indicate a shorter period of absorption, and in some instances an enhancement in reception at the higher end of the h-f spectrum. (auth)

18818 EFFECT ON RADIO CIRCUITS OF THE HIGH-ALTITUDE NUCLEAR DETONATION ON 9 JULY 1962. R. B. Hampton (Post and Telegraph Dept., Wellington, New Zealand). New Zealand J. Geol. Geophys., 5: 994-1002(Dec. 1962).

The observations made on commercial and other radio circuits in New Zealand and the Pacific area after the high-altitude nuclear explosion over Johnston Island are reported. Reports show that all circuits specifically observed were affected. The effects were widespread and began, as far as could be ascertained, at the moment of detonation. (auth)

18819 VARIATIONS IN THE TOTAL ELECTRON CONTENT OF THE IONOSPHERE AFTER THE HIGH-ALTITUDE NUCLEAR EXPLOSION. J. E. Titheridge (Univ. of Auckland, New Zealand). New Zealand J. Geol. Geophys., 5: 1003-8(Dec. 1962).

From measurements of the amplitude of the 54-Mc signals from the satellite Transit 4A, the total electron content of the ionosphere up to a height of 920 km is calculated. Thirty-five minutes after the high-altitude explosion the electron content over Auckland was twice the normal value of 4.2×10^{16} electrons per m^2. South of Auckland, over Nelson, the electron content increased to about three times the normal value. The Faraday fading of the signals almost completely disappeared north of Auckland, and this effect cannot be explained by normal ionospheric absorption of the extraordinary component. (auth)

18820 IONOSPHERIC EFFECTS AT CAMPBELL ISLAND ASSOCIATED WITH A HIGH-ALTITUDE NUCLEAR EXPLOSION. New Zealand J. Geol. Geophys., 5: 1009-10(Dec. 1962).

Ionograms taken following the Johnston Island July 1962 high-altitude nuclear explosion are discussed. (R.E.U.)

18821 EFFECTS OF JULY 1962 NUCLEAR EXPLOSION ON TIME-SIGNAL TRANSMISSIONS. B. R. Gibson (Dept. of Scientific and Industrial Research, Wellington, New Zealand). New Zealand J. Geol. Geophys., 5: 1012-15(Dec. 1962).

The high-altitude nuclear explosion over Johnston Island on July 9, 1962 did not affect the reception at Wellington of the time-signal transmissions from GBR (Rugby), WWV (Washington), WWVH (Hawaii), and JJY (Japan) as much as

was expected. The 16 kc transmission from GBR suffered a drop of only 3db for about 40 minutes after the explosion; WWVH and JJY were completely blacked out for about 44 minutes; and WWV was affected for a similar period, the 15 Mc signal being blacked out, the 10 Mc signal almost blacked out, and the 5 Mc signal only moderately affected. (auth)

18822 A POSSIBLE HYDROMAGNETIC DUCT IN RELATION TO HIGH-ALTITUDE EXPLOSIONS. F. B. Knox (Dept. of Scientific and Industrial Research, Lower Hutt, New Zealand). New Zealand J. Geol. Geophys., 5: 1016-18(Dec. 1962).

It is shown that at a height of 400 km in the atmosphere there may exist a hydromagnetic duct permitting propagation of effects for Johnston Island to New Zealand in the observed time of 40 sec. (auth)

18823 ENHANCEMENT OF THE X-RAY INTENSITY AT BALLOON ALTITUDES IN THE SOUTH AMERICAN ANOMALY. H. S. Ghielmetti (Comision Nacional de Energia Atomica, Buenos Aires), N. Becerra, A. M. Godel, H. Heredia, and G. Roederer. Phys. Rev. Letters, 12: 388-90(Apr. 6, 1964).

Data on bremsstrahlung x rays from three balloon flights over the Atlantic Ocean, approximately 900 miles east of Buenos Aires, are presented. The data verify the existence of an additional flux of low-energy x rays, detectable above 30 km altitude. It is suggested that this flux enhancement originates in electron bremsstrahlung, the electrons precipitating from the inner radiation belt or from the remainder of the "Starfish" fission electron belt. (L.B.S.)

18824 RECURRENT GEOMAGNETIC STORMS, SOLAR M-REGIONS AND THE SOLAR WIND. J. H. Piddington (Commonwealth Scientific and Industrial Research Organization, Sydney). Planetary Space Sci., 12: 113-18(Feb. 1964).

Evidence is reviewed indicating that the main features of geomagnetic storms of both types are caused by frictional interaction with the solar wind rather than by mere pressure on the geomagnetic cavity. If this is so then recurrent or M-region storms are caused by a property of the (steady) solar wind, which controls the frictional interaction. This property is the component of the interplanetary magnetic field in the geomagnetic equatorial plane. Hence M-regions are regions above which (projected along the streamlines) the magnetic field is unusually weak or lies at an angle $\sim\pi/2$ to this plane. (auth)

18825 IRREGULARITIES IN THE UPPER IONOSPHERE. J. H. Piddington (Commonwealth Scientific and Industrial Research Organization, Sydney). Planetary Space Sci., 12: 127-36(Feb. 1964).

The electron density distribution in ionospheric F-region shows irregularities of dimensions ranging from less than 1 to more than 1000 km. These were studied as spread-F, radio star scintillation, auroral structure, and other phenomena. A review of the experimental data indicates that at least in the case of spread-F there are two different phenomena with different origins. Low-latitude ($\lesssim 20°$) spread-F appears to be under the influence of the dynamo ionospheric region. It may be a secondary effect following the formation of a type of night-time sporadic-E. Sporadic-E patches will become electrically polarized in two ways; first as a result of the S_q electric current and second by turbulence in the dynamo region. The polarization field is efficiently transferred along the magnetic field lines to cause differential drifts in F-region. The mechanisms are modifications of those of Martyn and Dagg, respectively. High-latitude ($\gtrsim 40°$) spread-F is under the control of the DS electric field, which extends down from magnetospheric motions. These motions originate near the boundary of the geomagnetic field and are transferred to the ionosphere at high latitudes via hydromagnetic "twist" waves. They drive electric currents and drifts, the latter leading to outstanding accumulations of ionization in E-region. These accumulations react violently onto the magnetospheric motions, causing turbulence and creating small-scale irregularities, localized electric fields, precipitation of energetic trapped ions, spread-F, and columns of excess electron density at higher levels. A model of a hydromagnetic twist is shown to lead to the formation of a magnetospheric irregularity in the electron density distribution. 30 references. (auth)

18826 GEOMAGNETIC PULSATIONS WITH LATITUDE-DEPENDENT PERIODS AND THEIR RELATION TO THE STRUCTURE OF THE MAGNETOSPHERE. M. Siebert (Universität, Göttingen, Ger.). Planetary Space Sci., 12: 137-47(Feb. 1964).

The analysis of geomagnetic pulsations recorded simultaneously at German observatories, by means of standardized equipment, yields a systematic increase of the period with increasing geomagnetic latitude as far as the H-components of pc- and pse-type pulsations are concerned. The D-components, on the contrary, are very similar in shape at different latitudes. The most obvious explanation of these pulsations by field-aligned hydromagnetic oscillations in the magnetosphere requires the assumption of a lamellar structure of the plasma density in the region concerned. This conception also simply accounts for the frequently observed beats. The two pulsation types pc and pse are modifications of the same phenomenon due to different excitation mechanisms. The quantitative treatment of this model yields satisfactory agreement between theoretical and observational results. (auth)

18827 H_α EXCITATION IN THE HYDROGEN NEAR THE EARTH. T. M. Donahue (Univ. of Pittsburgh). Planetary Space Sci., 12: 149-59(Feb. 1964).

It is shown that it is possible to account for the H_α radiation observed in the night sky by radiative transport of Lyman-β, if the nocturnal hydrogen content of the geocorona is of an optical thickness large enough to account for observed Lyman-α excitation. It is necessary to assume a large variation during the solar dycle in the depth of reversal of the solar Lyman-β line to account for the H_α intensities reported whether the night-time Lyman-α is excited by single scattering in a geocoma or by multiple scattering in the geocorona. The variation needed is much larger for the geocomal explanation. The variation of H_α with solar elongation angle combined with the intensity data favors the geocoronal hypothesis. (auth)

18828 AN INSTANCE OF MOMENTARY INCREASE IN RADIATION INTENSITY, RECORDED 20 AUGUST, 1960 ON THE SECOND ARTIFICIAL EARTH SATELLITE. L. V. Kurnosova, L. A. Razorenov, and M. I. Fradkin. Planetary Space Sci., 12: 163-6(Feb. 1964).

Translated by O. M. Blunn from Iskusstv. Sputniki Zemli, Akad. Nauk USSR, No. 15, 66(1963).

Regions of highly charged particle radiation recorded by satellite off the coast of Brazil and near the Antarctic are reported. The detection and measurement are discussed. Possible production processes are discussed. (R.E.U.)

18829 IONIZATION IN THE D-REGION DURING AURORAL BREAK-UP EVENTS. Georg Gustafsson (Kiruna Geophysical Observatory, Sweden). Planetary Space Sci., 12: 195-208(Mar. 1964).

The investigation is based on photometer, riometer,

and magnetometer recordings covering a period of two years. The correlation between the three parameters was studied and was found to be very good between the auroral luminosity and the absorption of cosmic noise. Using the continuity equation the product ionization rate times recombination coefficient was obtained. The measured value was 5×10^{-6} ion pairs/sec^2 kR and with the electron density deduced from the simultaneous absorption measurements a recombination coefficient of 2×10^{-6} cm^3/sec was evaluated at the height of maximum absorption. The ionization rate that corresponds to the above recombination coefficient is higher than the ionization rate that was calculated for ionization by x rays. The conclusion drawn from these measurements is that the ionization causing the absorption is due mainly to directly ionizing particles. (auth)

18830 A MECHANISM OF INJECTION OF SOLAR PLASMA INTO THE MAGNETOSPHERE. J. R. Barthel and D. H. Sowle (General Dynamics/Astronautics, San Diego, Calif.). Planetary Space Sci., 12: 209-17(Mar. 1964).

It is shown that the interface between the geomagnetic field and the solar plasma stream is subject to instabilities of the Rayleigh-Taylor type when a solar plasma burst of sufficient intensity and suddenness reaches the magnetosphere following a solar flare. It is shown that clouds of this plasma can penetrate into the geomagnetic field to perhaps 3 Earth radii and break up, leaving charged particles in geomagnetic orbits with energies that are comparable to their directed kinetic energies before penetration. (auth)

18831 HYDROMAGNETIC COUPLING BETWEEN SOLAR WIND AND MAGNETOSPHERE. A. J. Dessler and G. K. Walters (Rice Univ., Houston, Tex.). Planetary Space Sci., 12: 227-34(Mar. 1964).

A model is presented by which changes in the direction of the interplanetary magnetic field can cause energy from the solar wind to be coupled to the magnetosphere. The energy is transferred by hydromagnetic waves generated by wagging of the tail of the magnetosphere. The wagging is due to time varying asymmetries in solar wind pressure in the vicinity of the magnetosphere, brought about principally by fluctuations in the direction of the interplanetary magnetic field relative to the solar wind velocity vector. A functional dependence is deduced that connects the fluctuation period of the direction of the interplanetary field to the geomagnetic α_p-index. (auth)

18832 A SURVEY OF IONOSPHERIC EFFECTS UPON EARTH-SPACE RADIO PROPAGATION. R. S. Lawrence, C. G. Little, and H. J. A. Chivers (National Bureau of Standards, Boulder, Colo.). Proc. IEEE (Inst. Elec. Electron. Engrs.), 52: 4-27(Jan. 1964).

The frequency dependence is derived and the order of magnitude is presented for various ionospheric effects upon radio waves with frequencies greater than the penetration frequency of the ionosphere. Among the phenomena considered are phase-path length change, refraction, frequency change, group-path delay, polarization rotation, and absorption. A detailed discussion is given of the mean value and variability of ionospheric absorption, refraction, scintillations, and polarization changes. 62 references. (auth)

Low Temperature Physics

Refer also to abstract 18149.

18833 THE CRITICAL CURRENT DENSITY OF AN Nb–Zr SUPERCONDUCTOR IN A PULSED MAGNETIC FIELD. Bruce Bailey Goodman, Jacques Lecomte, and Jean-Claude Vallier (Centre de Recherches sur les Tres Basses Temperatures, Grenoble, France). Compt. Rend., 258: 2296-9(Feb. 24, 1964). (In French)

The behavior of an Nb–Zr wire over a wide range of variable magnetic fields was studied. For field variations of 10^3 to 10^7 gauss/sec, the critical current density was considerably less than that in a constant field. (D.C.W.)

18834 MAGNETIC MOMENTS OF SUPERCONDUCTORS OF SMALL DIMENSIONS. Lung-tao Hsu and G. F. Zharkov. Fiz. Metal. i Metalloved., 15: 154-6(1963).

Magnetic moments of small specimens of superconductors were calculated according to formulas of nonlocal theory of Pippard. It was assumed that external field is distorted slightly by superconductors, and on expansion of integrals of magnetic moments to series in powers of the least dimension only the first terms were considered. The formulas so obtained show that susceptibilities (and magnetic moments) comprise in the Pippard case, as compared with that of London, an extraneous power of the smallest dimension of the specimen. (OTS)

18835 SUPERCONDUCTING-TO-NORMALLY CONDUCTING TRANSITIONS IN STRIP TRANSMISSION LINE STRUCTURES. A. R. Sass (Lewis Research Center, Cleveland) and F. J. Friedlaender. J. Appl. Phys., 35: 1494-1500(May 1964).

A theoretical and experimental investigation of superconducting-to-normally conducting transitions in strip transmission line structures is presented. The theoretical analysis is based on a macroscopic model, which is the transmission line analog of the Pippard model. It is assumed that during the transition a superconducting–normally conducting (S–N) interface propagates along the transmission line structure. This situation is treated theoretically as a moving boundary value problem. The S–N interface propagation velocity is determined explicitly in terms of the current that induces the transition, the operating temperature, and the superconductive penetration depth. Experimental results indicate that the model is useful for predicting the transition time of a strip transmission line structure. (auth)

18836 ALTERNATING CURRENT RESISTANCE OF NONIDEAL SUPERCONDUCTORS. Jacob L. Zar (Avco Corp., Everett, Mass.). J. Appl. Phys., 35: 1610-15(May 1964).

A direct electrical measurement is made of the resistance of nonideal superconductors at power and audio frequencies, at 4.2°K, and in zero applied field. The resistance of short samples of several Nb–Zr and Mo–Re alloys is found to be independent of the composition and of impressed current. The resistivity is found to depend on $f^{0.5}$ above 1000 cps and on $f^{1.7}$ for frequencies f below 500 cps. The resistance is also independent of wire diameter for some sizes near 0.25 mm. Three explanations are considered to account for resistance at low frequencies. Relaxation time effects are ruled out by the observed frequency dependence at high frequencies. Inductive coupling between the magnetic fields of the normal and the superconducting currents leads to a resistance effect six orders of magnitude lower than the observed ones, and an $f^{2.0}$ dependence. Trapping of flux within the superconductor leads to an upper bound for the resistance that agrees with the experimental results in being independent of the wire diameter and the current, and giving the approximately correct resistance values, although an $f^{1.0}$ dependence. The measurements suggest that the a-c resistance may result from eddy currents induced in normal regions near the surface of heavily cold-worked superconductors. (auth)

18837 THERMAL EXPANSION OF ANISOTROPIC METALS AT LOW TEMPERATURES. G. K. White (Commonwealth Scientific and Industrial Research Organization, Sydney). Phys. Letters, 8: 294-5(Mar. 1, 1964).

A sensitive capacitance technique was used to determine thermal expansions down to 1.5°K both parallel and normal to the major symmetry axes of magnesium and zinc (hexagonal close-packed), bismuth (rhombohedral), and tin (tetragonal). Results are tabulated for cylindrical samples. (R.E.U.)

18838 MICROWAVE OBSERVATION OF SUPERCONDUCTIVITY ABOVE THE UPPER CRITICAL FIELD. M. Cardona and B. Rosenblum (RCA Labs., Princeton, N. J.). Phys. Letters, 8: 308-9(Mar. 1, 1964).

The real part of the microwave surface impedance at 23 kMc was studied for Pb–50 wt % Tl alloy. Evidence was found for the surface superconductivity that nucleates at the plane boundary between a type II superconductor and an insulator, for magnetic fields parallel to the plane. The real part of the surface impedance is shown as a function of field strength and direction up to 6 kOersted. (R.E.U.)

18839 A SUPERCONDUCTING d-c DYNAMO DRIVEN BY A ROTATORY MAGNETIC FIELD. D. Van Houwelingen, P. S. Admiraal, and J. Van Suchtelen (Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). Phys. Letters, 8: 310-11(Mar. 1, 1964).

A superconducting d-c dynamo with a rotatory magnetic field was achieved by using a three-phase a-c in the stator windings of a normal squirrel-cage three-phase motor. An extra d-c field was superposed to obtain a superconducting region when a lead-coated brass foil was inserted between the stator and rotor of the motor. When a superconducting circuit of small self-inductance was connected to the lead foil, a current of 85 amp was reached immediately, and after switching off the a-c rotary field 70 amp persisted in the circuit. (R.E.U.)

18840 OHMIC TRANSPORT CURRENTS IN SUPERCONDUCTORS. P. Graneau (BICC Research Organization, London). Phys. Letters, 9: 5-6(Mar. 15, 1964).

Heat generation by alternating supercurrents is considered, and the consequences of emf's persisting in superconducting wires of any shape are examined. (C.E.S.)

18841 MAGNETIC BEHAVIOUR OF A SEMI-REVERSIBLE TYPE II SUPERCONDUCTOR. M. A. R. LeBlanc (Aerospace Corp., Los Angeles and Univ. of Southern California, Los Angeles). Phys. Letters, 9: 9-10(Mar. 15, 1964).

The magnetic behavior of several niobium wires were studied by the heat pulse ballistic technique. It is shown that the magnetic behavior of a semi-reversible type II superconductor can be understood in terms of a modified Mendelssohn sponge. (C.E.S.)

18842 PERTURBATION EXPANSIONS AND FUNCTIONAL INTEGRALS IN THE THEORY OF SUPERCONDUCTIVITY. J. S. Langer (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev., 134: A553-65(May 4, 1964).

A functional integral representation of the partition function for a superconductor is derived by conventional perturbation-theoretic techniques. The derivation involves a generalization of the ladder diagram expansion by means of a trick due to Gaudin, and the result turns out to be a variation of the functional integral derived by Hubbard. A saddle-point approximation then leads to the usual Bardeen-Cooper-Schrieffer equations. Although this approximation is mathematically unjustified, its predictions seem to be accurate. In particular, a very literal interpretation of the saddle-point method is supported by flux-quantization experiments. (auth)

18843 HEAT CAPACITY OF THE EXCHANGE BATH IN SOLID ^{3}He. R. L. Garwin and H. A. Reich (Columbia Univ., New York). Phys. Rev. Letters, 12: 354-7(Mar. 30, 1964).

An experiment to measure the exchange heat capacity of solid ^{3}He is described. The exchange heat capacity was measured in terms of the Zeeman heat capacity by r-f heating of the exchange bath and measuring the accompanying temperature rise. (L.B.S.)

18844 EFFECT OF MOTION ON Pb–Pb SUPERCONDUCTING CONTACTS. J. H. Simons and G. W. Farnell (McGill Univ., Montreal). Proc. IEEE (Inst. Elec. Electron. Engrs.), 52: 216(Feb. 1964).

The effects of motion on contacts between superconductors was studied using a rotating Pb–Pb contact. At temperatures where the bulk lead was normal, the standstill resistance ranged from 0.1 to 2 Ω and, in motion at speeds of about 4 rps, the resistance ranged from 0.5 to 10 Ω, the variation within one revolution being less than 0.5 Ω. In liquid helium, when the drum was stationary, the contact resistance was zero and the transition current was greater than the maximum current of 2 amp available with the existing apparatus. As soon as the drum was rotated at temperatures below 7°K, a contact resistance of the order of 1 mΩ appeared. It is noted that the magnitude of this turning resistance is about 10^{-3} times the resistance obtained for similar conditions above 7°K; also that the variations of resistance are essentiallv periodic with the rotation of the cylinder. (P.C.H.)

18845 THE BEHAVIOUR OF VORTEX LINES NEAR A WIRE IN LIQUID HELIUM II. D. J. Griffiths (St. Andrews Univ., Fife, Scotland). Proc. Roy. Soc. (London), Ser. A, 277: 214-36(Jan. 21, 1964).

By the application of classical hydrodynamics to the interaction between a wire and a parallel vortex line it is shown that states having different numbers of quanta of superfluid circulation about the wire are separated by high potential barriers. Possible ways of overcoming or avoiding the barriers are discussed, and it is concluded that such states are normally metastable. A method for finding steady vortex-line configurations is then developed, and it is found that, in an apparatus of the type used by Vinen (1961 b) to detect single quanta of circulation, states having vortex lines partly attached to the wire are metastable in certain circumstances. These results are compared with Vinen's account of his experiment. They agree well with the observations made when the apparatus had ceased to rotate. During rotation some points remain puzzling, but the failure to attain equilibrium, ascribed by Vinen to an anomalously large vortex core, is now seen to arise from the trapping of vortex lines in metastable states. A critical superfluid velocity of about 10^3 cm/s for the creation of vortex lines at a solid surface is derived, and, from this and the experimental observation of the stability of integral circulation about the wire against vibration, an upper limit of 3×10^{-6} cm to the vortex core radius is tentatively deduced. It is concluded that the theory of quantized vortex lines of small ($\approx 10^{-7}$ cm) core radius can account fairly well for the observations. Further possible tests of the theory are suggested. (auth)

18846 ON THE LAYER-FILAMENT STRUCTURE OF SUPERCONDUCTING Nb–Zr AND Nb–Ti ALLOYS. B. G. Lazarev, V. K. Khorenko, L. A. Korninenko, A. I. Krivko, A. A. Matsakova, and O. N. Ovcharenko (Inst. of Physics

and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 45: 2068-9(Dec. 1963). (In Russian)

Electron microscopic studies were made of the fine layer and filament structure in Nb–25 at. % Zr and Nb–66 at. % Ti alloys with critical magnetic fields of 10^5 Gauss and high critical current density (10^4 to 10^5 A/cm^2). (R.V.J.)

18847 ON THE ENERGY GAP ANISOTROPY IN SUPERCONDUCTING TIN. A. G. Shepelev (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 45: 2076-7(Dec. 1963). (In Russian)

Ultrasonic absorption (100 to 25 Mc) in pure tin monocrystals (containing $\sim 10^{-4}$% admixtures) at 1 to 4°K was studied with specimens oriented perpendicularly to the (101), (301), and (111) planes. (R.V.J.)

18848 SHAPE OF THE NUCLEAR MAGNETIC RESONANCE SIGNAL FROM SUPERCONDUCTING ALLOYS NEAR THE SECOND CRITICAL FIELD V. V. Shmidt (Inst. of Metallurgy, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 46: 649-53(Feb. 1964). (In Russian)

The expected shape of the nuclear magnetic resonance signal from superconductors of the second group near the second critical field is found, and its first four central moments are also found. (auth)

Neutron Physics

18849 (AAEC/E-114) MULGA—A COMPLEX OF CODES FOR THE DETERMINATION OF MULTIGROUP AVERAGED NEUTRON CROSS SECTION DATA. B. E. Clancy, G. Doherty, A. Keane, E. Kletzmayr, and J. P. Pollard (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Dec. 1963. 39p.

A complex of computer programs is described which produces multigroup cross sections in a format suitable for input into a selection of reactor codes. The calculational methods and operating instructions are outlined, and input and output are described. The programs, together with an associated microscopic data library tape, and a specialized monitor system, were coded for an IBM 1620 computer with 4 magnetic tapes. The basic programs MULGA 1 and MULGA 2 have already been adapted for an IBM 7090. (auth)

18850 (EUR-533.i) IL METODO DI GALERKIN E LA DOPPIA P_1 PER IL CALCOLO DEL FLUSSO TERMICO. (Galerkin's Method and the Double P_1 approximation for Thermal Flux Calculation). Adelia Daneri and Adriana Daneri (Milan. Università. Istituto di Fisica Teorica). 1964. 80p.

The program DESTHEC DP, in FORTRAN MONITOR for the IBM 7090, solves the transport equation for thermal neutrons in slab geometry. For the energy, Galerkin's method with the double P_1 approximation is used. Comparison shows good agreement between DESTHEC DP results and results obtained by the THERMOS program, which solves the transport equation in integral form. The theory is presented, and input and output are discussed. Numerical results are included, as well as the program listing. (D.C.W.)

18851 (IA-862) THE MULTIGROUP DIFFUSION ALTAC CODE FOR THE PHILCO-2000 COMPUTER. M. Lemanska, G. Szwarcbaum, and S. Yiftah (Israel. Atomic Energy Commission. Soreq Research Establishment, Rehoboth). Aug. 1963. 46p.

The multigroup, multiregion diffusion equation is solved for spherical geometry in the stationary case, using the method of "continuous calculation." The numerical process is outlined; and the DIFAL program, in ALTAC mnemonic language for the PHILCO TRANSAC S-2000 computer, is described. Criticality calculations made with DIFAL for ten ZPR-III assemblies and nine fast breeder power reactors are compared with previous results obtained with other programs. (auth)

18852 (MATT-231) ANALOGOUS DIFFUSION OF NEUTRONS AND PHOTONS: A PROPOSED EXPERIMENT. M. D. Kostin and R. C. Axtmann (Princeton Univ., N. J. Plasma Physics Lab.). Nov. 1963. Contract AT(30-1)-1238. 14p.

An analogy between the diffusion of thermal neutrons in a moderating medium and the diffusion of photons in a light scattering medium is investigated. Theoretical relations are given between the neutron and photon experiments which indicate that results obtained from one can be used to predict and estimate the results of the other. A possible experiment is described in which the photon flux in a suspension of polystyrene spheres in water is proportional to the thermal neutron flux in a water assembly of comparable size except possibly near boundaries, sources, and strong absorbers. The transport theory aspects of the analogy are briefly investigated, and a proportionality between the angular photon and neutron fluxes is suggested. (auth)

18853 (ZFK-TPH-8) BERECHNUNG DES AUSFLUSSSPEKTRUMS THERMISCHER NEUTRONEN. (Calculation of Thermal Neutron Emission Spectrum). Johannes Slotta (Germany. Zentralinstitut für Kernphysik, Dresden). Sept. 1961. 18p.

The spectrum of neutrons with energies less than 0.2 ev emerging from the free surface of a graphite column of a thermal reactor into a nonscattering medium is calculated by means of the neutron transport theory. The scattering mechanism of graphite is not well known and furthermore the calculation of the space and energy dependent transport equation in finite media is a very complex problem. Therefore simplifications are made, which reduce the problem to the solution of the monoenergetic integral equation for the Milne-Problem. The quantitative and qualitative difference in the scattering cross sections of neutrons below and above 1.8×10^{-3} ev, and an assumed isotropic scattering are used to simplify the calculation. If the distribution of neutrons deep in the interior of the graphite column is assumed to be Maxwellian, the emerging spectrum is found to be proportional to the product of the energy-dependent mean free path and the Maxwellian distribution in the interior of the column. The agreement with time-of-flight measurements is good. Deviations can be interpreted by the simplifications of the calculation. (auth)

18854 DOUBLE DIFFERENTIAL CROSS SECTION FOR SLOW-NEUTRON SCATTERING ON GASEOUS AMMONIA MOLECULES. B. Czerlunczakiewicz and A. Kowalska (Jagellonian Univ., Krakow). Acta Phys. Polon., 25: 141-4 (Jan. 1964).

A previously obtained experimental cross section for scattering of slow neutrons by ammonia is calculated using two theories. Results are given for 0.005-ev neutrons scattered 20°. (R.E.U.)

18855 SOLUTION OF THE UNIFORM TRANSPORT EQUATION. E. Ismatov (Inst. of Physics, Academy of Sciences Ukranian SSR). Izv. Akad. Nauk Uz. SSR, Ser., Fiz.-Mat. Nauk, No. 5, 54-7(1963). (In Russian)

A synthetic collision function was developed for the space-energy problem in neutron slowing down and diffusion. Results obtained with the function are in agreement with the uniform transport equation developed by D. V. Shirokov (Symposium, Reactor Physics and Thermal Technology Gosatomizdat, 1958). (R.V.J.)

18856 THE ABSORPTION OF NEUTRONS BY A NEUTRON SOURCE SURROUNDED BY A SPHERICAL CAVITY IN A WEAK BORON SOLUTION. T. B. Ryves (National Physical Lab., Teddington, Middz., Eng.). J. Nucl. Energy, Pt. A & B, 18: 49-60(Feb. 1964).

The neutron absorption in a spherical cavity surrounding a neutron source in a weak boron solution was investigated for a wide range of cavity radii, boron concentrations, and neutron-source spectra. The thermal-neutron flux density at the cavity was calculated by diffusion theory and measured by Mn–Ni foil activation. The results are applied to the absolute calibration of neutron sources by the manganese bath technique. (auth)

18857 A NEW METHOD FOR THE CONTAINMENT OF (α + Be) NEUTRON SOURCES. T. A. Cole and G. M. Temmer (Rutgers Univ., New Brunswick, N. J.). Nucl. Instr. Methods, 25: 179-80(Dec. 1963).*

The use of pyrex or quartz for encapsulation of neutron sources based on the Be(α,n) reaction is discussed. The purpose of using these substances is that they are permeable to He and that heating could drive out excess He. It is shown that, even without heating, the rate of He effusion is about equal to the rate of buildup. (T.F.H.)

18858 NEUTRON TRANSPORT IN CYLINDRICAL RODS. K. Bingham Cady and Melville Clark, Jr. (Massachusetts Inst. of Tech., Cambridge). Nucl. Sci. Eng. 18: 491-507(Apr. 1964).

A calculational method for Boltzmann's one-velocity, isotropic scattering transport equation is developed for cylindrical rods. The starting point is Peierl's integral equation, and the technique may be interpreted as a moments method or a variational method. Numerical results in the form of graphs are given for a set of standard problems. These problems include volume sources, surface sources, and the critical rod problem. For arbitrary, axially symmetric sources inside or outside the rod, a knowledge of the uncollided flux is sufficient to determine the escape probability from the rod in terms of these standard problems. (auth)

18859 AN IMPROVED FREE-SURFACE BOUNDARY CONDITION FOR THE P-3 APPROXIMATION. G. C. Pomraning (General Electric Co., Pleasanton, Calif.). Nucl. Sci. Eng., 18: 528-30(Apr. 1964).

Variational calculus is used to obtain an approximate free-surface boundary condition for the P_3 approximation in the monoenergetic neutron transport equations. Slab geometry is considered for simplicity. (C.E.S.)

18860 PREPARATION OF TARGET FOR PULSED NEUTRON GENERATOR BY IMPREGNATION OF DEUTERIUM IN EVAPORATED ZIRCONIUM FILM. Tchanhi Ri and Hirobumi Suzuki (Tokyo Univ.). Shinku, 6: 450-5 (Nov. 1963). (In Japanese)

Thin D-Zr targets for pulsed neutron generators for D-D reactions were prepared by impregnation of deuterium gas in vacuum-deposited Zr films on Cu bases. The Cu bases were made of OFHC, electrolytic Cu, and electrolytic Cu pre-coated with a thin Pt film by vacuum deposition. The atomic ratio of D to Zr in the target was determined to be 1 to 1.5 (D/Zr). The temperature of the Cu base was kept under 100°C by water cooling to eliminate reactions between residual gases in the evaporator and Zr atoms deposited on the base during the deposition process. The deuterium gas introduced into the apparatus for impregnation should be pure. If active gases, such as H_2O, O^2, and N^2, are included in the deuterium gas, the Zr film reacts with these gases and the amount of absorption of deuterium gas is markedly reduced. The apparatus and methods used for preparing the target are illustrated. The total amount and components of gases impregnated in the target are discussed. (from NSA of Japan)

18861 NEUTRON FLUX INTENSITY DETECTION. James T. Russell (to U. S. Atomic Energy Commission). U. S. Patent 3,130,307. Apr. 21, 1964.

A method of measuring the instantaneous intensity of neutron flux in the core of a nuclear reactor is described. A target gas capable of being transmuted by neutron bombardment to a product having a resonance absorption line at a particular microwave frequency is passed through the core of the reactor. Frequency-modulated microwave energy is passed through the target gas and the attenuation of the energy due to the formation of the transmuted product is measured. (AEC)

Nuclear Properties and Reactions

Refer also to abstracts 18174, 18222, 18744, 19124, 19360, and 19361.

18862 (ANL-6725(p.243-6)) DETERMINATION OF NUCLEAR CONSTANTS. C. E. Crouthamel (Argonne National Lab., Ill.).

The program for the measurement of neutron cross sections of elements of importance to fast reactor technology was continued. Preliminary data on the capture cross section of ^{187}Re were obtained, and studies of neutron total cross sections of rhenium as a function of neutron energy were begun. The total neutron cross sections of gadolinium were determined as a function of neutron energy between 9 and 1880 kev. The neutron capture cross sections of ^{170}Er were determined for neutron energies between 0.34 and 1.9 Mev. The cross section data for the three elements are presented in graphical form. (auth)

18863 (ANL-6792(p.11-27)) NEUTRON CROSS-SECTION MEASUREMENTS AT HARWELL IN SUPPORT OF THE U. K. FAST REACTOR PROGRAMME. A. T. G. Ferguson and N. J. Pattenden (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

Measurements of the average number of neutrons per fission, cross sections for inelastic neutron scattering in the Mev region, and neutron total, fission, and capture cross sections in the resonance region are presented. (C.E.S.)

18864 (ANL-6792(p.29-50)) RECENT CHANGES IN HEAVY ELEMENT CROSS SECTIONS. A. B. Smith (Argonne National Lab., Ill.).

Recently determined values of fission cross sections, neutron yields per fission, delayed neutron yields, and neutron capture and scattering cross sections are compared with previous values. An attempt is made to prognosticate the future progress in the field of fast neutron fission, capture, and scattering. (C.E.S.)

18865 (ANL-6792(p.695-709)) NEUTRON CROSS SECTIONS IN FISSILE ELEMENTS. D. B. Adler and F. T. Adler (Illinois. Univ., Urbana).

An analytical method used to obtain the formulas for the neutron cross sections of fissile elements is outlined. The results are final expressions for low-energy neutron

cross sections of heavy elements obtained from the Wigner-Eisenbud theory without special assumptions in the form of superposition of interfering resonance terms. (C.E.S.)

18866 (ANL-6792(p.885-95)) EXPERIMENTAL RESULTS FOR U^{238} DOPPLER MEASUREMENTS IN FAST REACTOR SPECTRA. G. J. Fischer, H. H. Hummel, J. R. Folkrod, and D. A. Meneley (Argonne National Lab., Ill.).

Doppler reactivity measurements were made for uranium-238 heating in two-zoned core loadings of the ZPR-III fast critical assembly. The central zone of the first loading, in which the measurements were made, had the composition of a 5000-liter uranium monocarbide fast power breeder. The second central-zone loading differed from the first by replacement of 40% of the sodium with graphite. This change gave an increased Doppler reactivity effect and a second point for theoretical comparison. The design of the Doppler element and of the core loading, both of which were planned to minimize non-Doppler reactivity effects, is described. Supplementary experiments which show that non-Doppler reactivity effects must represent at most a small part of the observed reactivity change are discussed. An experiment which tested the importance of resonance depression of the neutron flux incident upon the element, due to adjacent ^{238}U in the central-zone loading, is described and results are given. Calculational comparisons with these experimental results using recently developed ANL cross sections are reported. They show close agreement with the first experiment and poorer agreement with the softer spectrum case. (auth)

18867 (ANL-6792(p.897-912)) FAST SPECTRUM DOPPLER MEASUREMENTS OF Th^{232}, U^{238}, AND U^{235} METALS. T. H. Springer and S. G. Carpenter (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.).

Doppler effect measurements for ^{232}Th, ^{235}U, and ^{238}U performed in the AETR fast spectrum are presented and compared with theoretical results. (C.E.S.)

18868 (CERN-64-17) HIGH-ENERGY NUCLEAR REACTION CROSS SECTIONS. [PART] III. E. Bruninx (European Organization for Nuclear Research, Geneva). Mar. 18, 1964. 119p.

Cross sections based on new values (given) for the cross sections of the monitor reactions $^{27}Al(p,3pn)^{24}Na$ and $^{12}C(p,pn)^{11}C$ are tabulated for the production of specific nuclei in proton reactions on nuclei from Be through U. Cross sections for production by gamma reactions on B and Ni; deuteron reactions on Cu, Th, U, Ar, Ne, Mg, N, C, and Al; alpha reactions on U, Th, Al, and C; ^{12}C ions on Au and Al; and by ^{6}Li, ^{14}N, and ^{16}O ions on Al are also included. (D.C.W.)

18869 (HW-60431) FISSION PRODUCT YIELD OF INERT GASES. K. R. Merckx (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 19, 1959. Contract AT(45-1)-1350. 2p.

Xenon and krypton yields in uranium and plutonium fission are discussed. The final percentage of Xe created by fission in U and Pu is a function of the neutron flux intensity. The flux dependence results because ^{133}Xe and ^{135}Xe can be converted to a stable Xe isotope by neutron capture instead of decaying into Cs. The yield of Xe can vary by ~9% for U and ~8.5% for Pu. Yields of Kr and Xe for various fluxes are tabulated. (P.C.H.)

18870 (JINR-E-1534) ENERGIES OF THE QUADRUPOLE STATES OF STRONGLY DEFORMED EVEN-EVEN NUCLEI. Lu Yuang, V. G. Solov'ev, and A. A. Korneichuk (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 16p.

The energies of the beta and gamma vibrational states of even-even, strongly-deformed nuclei are calculated for $152 \leq A \leq 186$ and $228 \leq A \leq 264$. Satisfactory agreement with experimental data is obtained with judicious selection of the constant of quadrupole-quadrupole interaction. It is shown that for Dy and Er isotopes, the energies of the gamma vibrational states are less than those of the beta vibrational states, in correspondence with experimental data. It is noted that the lowest states with $K\pi = 2+$ and $0+$ (K = momentum projection) possess pronounced collective properties, and their energies are considerably < the energies of the nearest poles in the secular equations. In some cases the energies of the quadrupole states are near the poles, and their wave functions are very close to those of the two-quasiparticle states. The calculated E2 transition probabilities do not contradict the experimental data. (auth)

18871 (JINR-P-1509) ISSLEDOVANIE SPEKTROV KONVERSIONNYKH ELEKTRONOV IZOTOPOV ERBIYA I GOL'MIYA S $T_{\frac{1}{2}} \leq 18$ KCEK. (The Investigation of Conversion Electron Spectra of Erbium and Holmium Isotopes with $T_{\frac{1}{2}} \leq 18$ ksec). A. A. Abdumalikov, A. A. Abdurazakov, K. Ya. Gromov, F. N. Mukhtasimov, and G. Ya. Umarov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 14p.

A beta spectrometer with a constant magnetic field was used to study the spectra of conversion electrons in the decay of ^{159}Er, ^{159}Ho, ^{156}Ho, and ^{155}Ho in the energy range 25 to 1000 kev. The resolution of the spectrometer was about 0.07%. A decay scheme for ^{159}Er and ^{159}Ho is proposed. More accurate data on the conversion electrons of ^{156}Ho was obtained, and several previously unreported gamma transitions in ^{156}Ho and ^{155}Ho were observed. (auth)

18872 (JINR-P-1521) OTNOSHENIE SECHENII OBRAZOVANIYA IZOMERNOI PARY $Sc^{44,44m}$ V REAKTSIYAKH PRYAOGO VZAIMODEISTVIYA S TYAZHELYMI IONAMI. (Ratio of Cross Sections for Production of an Isomer Pair in Direct Interaction Reactions with Heavy Ions). V. A. Fomichev, B. A. Gvozdev, and V. V. Bredel (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1964. 11p.

The isomer ratio $^{44}Sc/^{44m}Sc$ in the neutron stripping reactions of ^{22}Ne and ^{16}O ions on scandium was measured. It was determined to be about 1 and to be energy independent. It is shown that the isomer ratio in the multinucleon transfer (3pn) in the reaction $^{27}Al + {}^{40}Ar \rightarrow {}^{44,44m}Sc$ is equal to about 6.5. (auth)

18873 (JINR-P-1532) VOZBZHDENIE YADER PRI RASSEYANII TYAZHELYZH IONOV. (Excitation of Nuclei in Heavy Ion Scattering). V. K. Luk'yanov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 12p.

The excitation of nuclei by heavy ion scattering in the subbarrier region ($E < V_{Coloumb.}$) is investigated. The Coulomb and peripheral nuclear interaction of the heavy ion with the nucleus is taken into account. A quantum-mechanical excitation cross section is given for the nuclear transitions with λ multipole, as well as a quasi-classical expression. A concrete calculation is made for the case of the monopole transition in ^{40}Ar and ^{12}C scattering on ^{156}Gd. The monopole transitions are excited by the nuclear interaction only and are forbidden in the usual Coulomb excitation. The cross sections were found to be 10^{-27} to 10^{-32} cm^2, indicating the possibility of measuring them. (auth)

18874 (JINR-P-1546) NEITRONNYE REZONANSY PRAZEODIMA I TERBIYA. (Neutron Resonances of Praseodymium and Terbium). Nai-yen Wang, N. Iliesku, E. N. Karzhavina, Hi San Kim, A. B. Popov, L. B. Pikelner, T. Stadnikov, E. I. Sharapov, and Yu. S. Yazvitskii (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Neutron Physics). 1964. 15p.

The parameters of ^{159}Tb and ^{141}Pr resonances, including the values of spins for some levels, were determined by measuring the transmission, capture, and scattering of neutrons. Twenty-two levels in the energy range up to 100 ev were analyzed for ^{159}Tb. For ^{141}Pr, 14 levels in the energy interval up to 1000 ev were analyzed. Four of the fourteen levels were previously unreported. The mean value of the radiative widths of ^{159}Tb and ^{141}Pr levels was found to be the same (86 Mev). (auth)

18875 (JINR-P-1547) METODY KALIBROVKI PRI IZMERENII SECHENIYA RADIATSIONNOGO ZAKHVATA NEITRONOV. (Calibration Methods in Measuring the Capture Neutron Cross Section). L. B. Pikelner and E. I. Sharapov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Neutron Physics). 1964. 9p.

The calibration methods applied in the measurement of neutron radiative capture in order to get the resonance parameters are described. The calibration of a large-volume scintillation detector in coincidence is considered, and the constancy of the effectiveness in different resonances is discussed. (auth)

18876 (KFK-185) DIE EMISSION VON PROTONEN AUS LEICHTEN NEUTRONENARMEN ATOMKERNEN (PROTONENZERFALL; DOPPELTER PROTONENZERFALL; β^+-ZERFALL MIT NACHFOLGENDER PROTONENEMISSION). (The Emission of Protons from Light Neutron-Deficient Nuclei (Proton Decay; Doppler Proton Decay; β^+-Decay with Following Proton Emission)). Joachim Jaenecke (Kernforschungszentrum. Institut für Experimentelle Kernphysik, Karlsruhe, Germany). Nov. 1963. 65p.

Processes that lead to the emission of protons by light neutron-deficient nuclei are discussed. These processes are proton decay, double proton decay, and β^+ decay with subsequent proton emission. Stability limits against proton decay were calculated for nuclei with $Z \leq 14$, which deviated insignificantly from the limits given by Goldansky. The influence of the original and resulting nuclei and the centrifugal ridge for the emitted proton was considered. Principles were developed for the detection of protons from various decay processes. Half lives and proton energies were calculated for ^{5}Li, ^{9}B, ^{16}F, ^{4}Li, ^{11}N, ^{15}F, ^{18}Na, ^{22}Al, ^{5}Be, ^{6}Be, ^{12}O, ^{16}Ne, ^{19}Mg, and ^{22}Si. Data were obtained for naturally occurring isotopes of these elements. (M.C.G.)

18877 (LAMS-3053) A SEARCH FOR THE MÖSSBAUER RESONANCE OF THE 137-kev γ RAY OF Fe^{57}. T. A. Kitchens, W. A. Steyert, and R. D. Taylor (Los Alamos Scientific Lab., N. Mex.). Feb. 24, 1964. Contract W-7405-eng-36. 14p.

An unsuccessful attempt was made to observe the Mossbauer absorption and re-emission of the gamma ray associated with the 137-kev, 8-nsec level in ^{57}Fe. The geometry employed is shown to be very sensitive to small resonances; the background is quantitatively explained; and the Mossbauer recoil-free fraction is shown to be no larger than that predicted by the Debye theory. (auth)

18878 (NASA-TN-D-2120) A FORTRAN PROGRAM FOR ANALYSIS OF SPIN ZERO ELASTIC SCATTERING WITH THE NUCLEAR OPTICAL MODEL. C. C. Giamati (National Aeronautics and Space Administration. Lewis Research Center, Cleveland), W. Tobocman (Case Inst. of Tech., Cleveland), and D. V. Renkel (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Apr. 1964 50p.

The program ELSA analyzes the elastic scattering of spin-zero particles from an atomic nucleus which is represented by the nuclear optical model in the form of a Saxon-Woods volume potential plus a surface interaction potential, the radial dependence of which is in the form of the derivative of a Saxon-Woods form factor. There are available four independent parameters of each of the two potentials; the strengths of the real and imaginary parts of the potential, the radius of the potential, and the diffuseness parameter. Provision is made for varying these parameters over a chosen grid in the parameter space or for searching for a best fit to experimental cross section data by minimizing the chi-squared deviation as a function of chosen parameters. Since most of the computation time is expended in integrating the radial wave equation, the method of integration chosen is about twice as fast as the commonly used Runge-Kutta method. The mathematical formulation and program listing are included. (auth)

18879 (NP-13722) SECTIONS EFFICACES POUR LES DETECTEURS DE NEUTRONS PAR ACTIVATION—RECOMMANDEES PAR LE GROUPE DE DOSIMETRIE D'EURATOM; ET COEFFICIENTS POUR LES CALCULS DE FLUX ET DE SPECTRES A PARTIR DES MESURES D'ACTIVATION. (Effective Cross Sections for Detectors of Neutrons by Activation—Recommendations by the Euratom Dosimetry Group; and Coefficients for Flux and Spectra Calculations Beginning with Activation Measurements). R. Beauge (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). 1963. 102p.

Effective cross sections for several reactions used to detect neutrons are compiled, together with coefficients used in determining flux and spectra from the activation measurements. (D.C.W.)

18880 (NP-13773) STRIPPING AND KNOCKOUT AMPLITUDES FROM GAUSSIAN INTERACTIONS OF FINITE RANGE. Fernando B. Morinigo (California Inst. of Tech., Pasadena). 1963. 22p.

A plane-wave theory of stripping reactions is presented in which finite-range interactions are used for the knockout modes, and radial integrals are not cut off at a nuclear radius. Capture into an orbit of any value of L and particles of arbitrary spin are treated. Gaussian shapes are assumed for the potentials; harmonic oscillator shapes are used for the bound state wave functions. The cross sections for the domination of the two direct modes or the two exchange modes are calculated. (D.C.W.)

18881 (NP-13784) REAKTSIYA (d,t) NA LEGKIKH YADRAKH. ((d,t) Reaction in Light Nuclei). A. A. Ogloblin (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii and Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoĭ Energii). 1963. 99p.

The (d,t) reactions on 12 targets (^{6}Li, ^{7}Li, ^{9}Be, ^{11}B, ^{12}C, ^{16}O, ^{18}O, ^{19}F, ^{24}Mg, ^{25}Mg, ^{26}Mg, and ^{27}Al) were investigated by measuring the triton spectra for a wide range of energies (0.12 to 15 Mev) and angular intervals. The main feature of the method was the measurement of tritons in the complete absence of background. The measurements showed that the (d,t) reaction is quite similar to the (p,d) reaction, and in all cases the triton angular distribution

(primary maximum) was well described by Battler theory. The distribution of excited levels in residual nuclei showed the distinct regularity anticipated for capture reactions. Probabilities for lower levels with structures close to the ground-state structure were high; probabilities for levels with energies above ~5 Mev were considerably smaller. The capture reaction differs from the stripping reaction in which intense excitation of high single-particle states occurs. Correlations of (d,t) and (p,d) reactions were used in an investigation of nuclear structure, and it was found that widths from (d,t) reactions can be used in nuclear spectrometry just as in (p,d) reactions. Widths for 1p shells were compared with shell models with intermediate bonding. Width measurements on the 2s–1d shell (^{18}O and ^{19}F) indicated many configurations. According to theory the $2s_{\frac{1}{2}}$ and $1d_{\frac{3}{2}}$ shells are strongly mixed. The results for ^{25}Mg and ^{26}Mg indicate a rotational structure and rotation bond mixing. Neutron capture from saturated shells ($1s_{\frac{1}{2}}$ on ^{9}Be, 1p on ^{18}O and ^{19}F) was observed. The vacancy level for ^{8}Be was found at ~17 mev and for ^{17}O and ^{18}F at 3 Mev. It was also found that for 20-Mev deuterons the total triton cross sections can reach large magnitudes (~350 mb for Li isotopes). (R.V.J.)

18882 (TID-20378) FINAL REPORT [ON NUCLEAR PHYSICS]. M. Dresden (Iowa. State Univ., Iowa City). Mar. 25, 1964. Contract AT(11-1)-72. 63p.

Separate abstracts were prepared for the two sections of the report. (D.C.W.)

For abstracts of individual papers see: 18647 and 18883.

18883 (TID-20378(Sect.2)) ON THE ACCURACY OF LINEARIZATION APPROXIMATIONS FOR SINGLE-CLOSED-SHELL NUCLEI. S. Cohen, R. D. Lawson, M. H. MacFarlane (Argonne National Labs., Ill.); and M. Soga (Tokyo Inst. of Tech.). 12p.

The energies of levels with spins of $\frac{5}{2}$, $\frac{3}{2}$, and $\frac{1}{2}$ were calculated in the quasi-particle random phase approximation and its limiting case, the Tamm-Dancoff approximation, in which the ground-state correlations are neglected. The results were compared with exact shell-model calculations for even numbers of identical nucleons (2 to 10) in these levels. The influence of the triplet-singlet strength ratio was examined by exact and BCS approximation calculations of ground-state wave functions. (D.C.W.)

18884 (TID-20390) BETA-GAMMA DIRECTIONAL CORRELATION STUDIES IN Co^{60} AND Tm^{170} (thesis). Frank Carlisle Davis (Vanderbilt Univ., Nashville. Graduate School). Aug. 1963. 80p.

A magnetic lens spectrometer was constructed for beta-gamma directional correlation studies. The performance of the gamma detector was investigated by finding the peak-to-total ratios of ^{137}Cs, ^{203}Hg, and ^{65}Zn for three different gamma-ray energies and several source-to-detector distances. Although the C-4 coincidence unit was replaced because of its instability, subsequent investigation of the asymmetrical error showed that it was more satisfactory than was originally believed. The investigation of the beta-gamma directional correlation for Co^{60} with the new coincidence unit shows it to be isotropic, as is known, when proper care is taken on N_γ and M_γ (singles and amplifer count rates). The new coincidence unit has a high coincidence efficiency and performs well for beta-gamma directional correlations. The beta-gamma directional correlation for ^{170}Tm was made, and values of $A_2 = -(0.067 \pm 0.010)$ and $A_2 = -(0.117 \pm 0.010)$ were found for beta energies of 500 kev and 633 kev, respectively. The results are in agreement with previous work. A correction for inner bremsstrahlung was not applied to the data. The values of A_2 may be corrected however, by subtraction of approximately 0.01. (auth)

18885 (TID-20394) K, L, AND M INTERNAL CONVERSION COEFFICIENTS IN THE DECAY OF EUROPIUM-152 (thesis). Robert John Herickhoff (Vanderbilt Univ., Nashville. Graduate School). Aug. 1963. 28p.

The internal-external conversion method was tested for scattering effects. Scattering effects should be exhibited by a change in α_K with an increase in converter thickness. The measurements of α_K of the 344-kev transition in Gd^{152} yielded values of $(291 \pm 15) \times 10^{-4}$, $(293 \pm 15) \times 10^{-4}$, and $(287 \pm 15) \times 10^{-4}$ for the 1.12, 2.19, and 3.71 mg/cm^2 converters respectively. These results indicate that a converter thickness of 3.71 mg/cm^2 may be used at an energy of 344 kev. Combining the results for the three converters gives the result $\alpha_K = (290 \pm 8) \times 10^{-4}$, which is lower than the theoretical value 310×10^{-4}. The result agrees within limits of error with the value $(283 \pm 8) \times 10^{-4}$ of Lu obtained by a coincidence method. The average of these two values, $(287 \pm 8) \times 10^{-4}$, is about 7% lower than the theoretical value. This deviation is about three times the error in α_K. The K/L ratio of the 344-kev transition in ^{152}Gd is found to agree with theory. The K/M+ deviation reported by other workers has been found for this transition also. Indications are that the K/M+ theoretical value, for which screening has not been taken into account, multiplied by 1.6 agrees with experimental results at this Z. (auth)

18886 (TID-20421) A TEST OF THE INTERNAL-EXTERNAL CONVERSION METHOD AND APPLICATION TO CONVERSION COEFFICIENT MEASUREMENTS IN Ba^{134} (thesis). Edward Francis Zganjar (Vanderbilt Univ., Nashville. Graduate School). May 1963. 66p.

The internal-external conversion method for conversion coefficient measurements is described, and the possible effects of scattering of the photoelectrons in the converter material are discussed. It is shown that the extent of the scattering depends on the converter thickness and gamma-ray energy. The effect of this scattering on the correction factor is examined. A method for experimentally testing for scattering distortions by measuring conversion coefficients with converters of different thicknesses and with different source to converter distances is described. Measurements were made at the gamma-ray energy of 605 kev with uranium converters of thickness 1.12, 2.19, and 3.71 mg/cm^2. The consistent results for the measurements of the K conversion coefficient of the 605 kev transition in ^{134}Ba indicated that scattering may be neglected at the gamma energy of 605 kev for a converter thickness $\leq$3.71 mg/cm^2. The average of all the K conversion coefficients of the pure E2 605-kev transition in ^{134}Ba was found to be $(5.03 \pm 0.2) \times 10^{-3}$ in excellent agreement with the theoretical values of Rose (5.08×10^{-3}) and Sliv (5.1×10^{-3}). The experimental L conversion coefficient, $(7.07 \pm 0.49) \times 10^{-4}$, agrees with the theoretical value of Rose (6.92×10^{-4}); but the experimental M conversion coefficient, $(1.64 \pm 0.18) \times 10^{-4}$ is 41% below Rose's theoretical value (2.77×10^{-4}). The discrepancy between experiment and theory for the M conversion coefficient is attributed to the fact that screening effects were neglected in the theoretical calculations. (auth)

18887 (ZFK-PHA-11) DIE BEDEUTUNG DER COULOMBANREGUNG FUR DIE THEORIE DER ATOMKERNE. (The Significance of Coulomb Excitation for the Theory of Atomic Nuclei). Malavalli N. Viswesvariah (Germany.

Zentralinstitut fur Kernphysik, Dresden). Sept. 1963. 41p.

Research on Coulomb excitation reported in the published literature up to 1961 is summarized. 264 references. (D.C.W.)

18888 PREPARATION OF ISOTOPIC BARIUM CARBONATE TARGETS BY ELECTROPHORESIS FOR CYCLOTRON IRRADIATION EXPERIMENTS. Elena Trutia and Tatiana Magda (Inst. of Atomic Physics, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 14: 723-4 (1963). (In Rumanian)

The study of nuclear reactions of charged particles requires the use of thin and uniform targets, in order to minimize the energy losses of the beam. The electrophoretic deposition method was found to be convenient for the preparation of deposits with thicknesses of a few tens of microns. This method was used for preparing enriched Ba isotopes. Previously polished and chemically cleaned Ta foils were used as the support. The ground powder was suspended in acetone and then placed in the Teflon cell where it was magnetically stirred. The deposition was completed in 20 seconds with an applied voltage of 600 v. Layers of ^{137}Ba and ^{138}Ba carbonates and La oxide were prepared with thicknesses ranging from 2 to 3 to about 30 microns. The Ba targets were exposed to a 5.9-Mev proton beam for 25 hours without being destroyed. (TTT)

18889 EXCITATION OF NUCLEAR LEVELS BY ELECTRON BOMBARDMENT. H. Zingl (Universität, Graz). Acta Phys. Austriaca, 17: 190-4(1964). (In German)

Kinematic calculations show that the inaccuracies in the knowledge of the excitation energies leads to the same inaccuracies in the energy of the scattered electrons. If it were possible to determine the electron energies to 1 kev, the excitation energies would conversely have the same accuracy. The energies of electrons scattered on C^{12} were tabulated for incident energies of 25, 50, 100, 250, and 500 Mev at various scattering angles. (J.S.R.)

18890 RESONANCE REACTIONS AND THE NUCLEAR SHELL MODEL. [PART] I. Richard H. Lemmer and Carl M. Shakin (Massachusetts Inst. of Tech., Cambridge). Ann. Phys. (N. Y.), 27: 13-57(Mar. 1964). (TID-19384)

H. Feshbach's unified theory of nuclear reactions was applied to the calculation of elastic neutron scattering from a ^{15}N target. The target nucleus is considered to be adequately described as a $p_{1/2}$ hole configuration relative to the ^{16}O core. The method takes into account the formation of compound states of the one particle-one hole type that arise as intermediate states during the scattering process. No interaction radius is introduced and properly antisymmetrized wave functions are used throughout. The elastic scattering cross section is calculated for energies of the incident neutron up to 10 Mev neglecting the presence of inelastic channels, the lowest of which opens up at 5.28-Mev neutron energy. Resonance energies and widths are predicted for negative parity states having J = 0, 1, 2, 3, and 4 in this energy range. The predicted widths range from 0.6 to 800 kev and are of the order of magnitude of those found experimentally. One interesting aspect of the calculation is the appearance of strong coupling effects in the $J = 1^-$ channel in the vicinity of the single particle resonance. It is shown that this feature can lead to narrow resonances in the cross section that have no analog in a weak coupling treatment of the problem. (auth)

18891 DEUTERON PHOTODISINTEGRATION AND N-P CAPTURE BELOW PION PRODUCTION THRESHOLD. F. Partovi (Massachusetts Inst. of Tech., Cambridge). Ann. Phys. (N. Y.), 27: 79-113(Mar. 1964).

A nonrelativistic, phenomenological treatment of deuteron photodisintegration and radiative n-p capture is presented. The only approximations made are the neglect of nucleon structure, pion exchange currents, and multipoles higher than the octupole. In addition to the total and differential cross section, all parameters necessary to specify the final polarization with an arbitrarily polarized incident beam are calculated. Photodisintegration is calculated at laboratory photon energies of 10, 20, 40, 60, 80, 100, 120, and 140 Mev, and n-p capture of laboratory neutron energies of 0.1 and 0.548 Mev. Hamada's potential is used for computation of the wave functions. Photodisintegration calculations are done in several approximations to exhibit the effect of various terms. It was found that spin E1 and spin M2 transitions to triplet states, usually omitted, are important. The thermal neutron capture cross section found from exact wave functions shows an improvement of 2% over the zero-range approximation, thus accounting for some of the discrepancy with experiment. It is hoped that this improvement will close the 5% gap between experiment and zero-range theory when a potential that fits the singlet scattering length better than Hamada's is used. Results are compared to experiment where possible. 34 references. (auth)

18892 EFFECTS OF PARITY NONCONSERVING INTERNUCLEON POTENTIALS ON THE PHOTOEFFECT IN H^2. F. Partovi (Massachusetts Inst. of Tech., Cambridge). Ann. Phys. (N. Y.), 27: 114-32(Mar. 1964).

The effect of parity nonconservation on the photodisintegration of the deuteron and on the radiative capture of neutrons by hydrogen is studied. Photodisintegration is calculated at laboratory photon energies of 10, 20, 40, 60, 80, 100, and 140 Mev, and n-p capture at laboratory neutron energies of 0.1 and 0.548 Mev. The internucleon potential of Hamada plus the parity nonconserving potential of Blin-Stoyle are used to represent the proton-neutron interaction. The following experimental ratios (which would vanish for parity conserving forces) were calculated and all found to be less than 10^{-7}, and therefore too small to be measurable. The asymmetry of the cross section with respect to the plane of γ-ray polarization and the nucleon polarization in the plane of scattering for unpolarized incident γ rays were measured for photodisintegration. The up-down asymmetry in the cross section with polarized incident neutrons and the net circular polarization of the outgoing photons with unpolarized incident neutrons were measured for n-p capture. (auth)

18893 NUCLEAR GROUND-STATE SPIN AND MAGNETIC MOMENT OF Au^{190}. G. Liljegren, I. Lindgren, L. Sanner, and K. E. Aedelroth (Uppsala Univ.). Arkiv Fysik, 25: 107-10(1964).

The atomic-beam magnetic-resonance method was employed to measure the ground-state spin and the hfs separation of ^{190}Au with the results I = 1 and $\Delta\nu = (3004 \pm 7)$ MHz. The magnetic dipole moment (μ_I) is calculated from the hfs separation by means of the known values of ^{197}Au and the Fermi-Segrè formula with the result $|\mu_I| = 0.063$ nm. All attempts to find the spin of ^{189}Au were unsuccessful, and some evidence is given that the half life of this isotope is quite different from the reported 42 minutes. (auth)

18894 AN INVESTIGATION OF THE GAMMA-RAY DECAY OF THE $Ca^{44}(p,\gamma)Sc^{45}$ 1.660 Mev RESONANCE. Bengt Erlandsson and Kalevi Valli (Univ. of Lund, Sweden). Arkiv Fysik, 25: 143-57(1964).

A target of ^{44}Ca was bombarded with protons at energies from 1.3 to 2.5 Mev. The gamma-ray yield was measured as function of the proton energy. The maxima that were ob-

served in the yield curve correspond to excited states in the compound nucleus ^{45}Sc. The gamma rays emitted by the 1.660-Mev resonance were studied. The decay scheme of this level was investigated with a three crystal pair spectrometer and gamma-gamma coincidence techniques. (auth)

18895 BETA-GAMMA DIRECTIONAL CORRELATION IN THE DECAY OF Hg^{203}. Ekbal Bashandy and M. S. El-Nesr (Uppsala Univ.). Arkiv Fysik, 25: 159-65(1964).

The directional correlation between the 207-kev beta-group and the 279-kev gamma ray in the decay of ^{203}Hg was measured as a function of the energy of the beta-particles. A magnetic-lens spectrometer was used as beta energy analyzer. The anisotropy factor $A_2(W)$, in the beta-gamma directional correlation function, $W_{\beta\gamma}(\theta,W) = 1 + A_2(W)\ P_2\cos(\theta)$, is proportional to P^2/W and increases in a negative direction from 0 to (-0.039 ± 0.006) at 160 kev beta-energy. It is also shown that the ξ-approximation for first-forbidden beta decay represents the experimental data of ^{203}Hg. (auth)

18896 THE PROBABILITY OF THE TRIPLE FISSION OF URANIUM-235 BY MONOENERGETIC NEUTRONS IN THE 0.06 TO 10 ev ENERGY RANGE. T. A. Mostovaya, V. I. Mostovoi, and G. V. Yakovlev. At. Energ. (USSR), 16: 3-8(Jan. 1964). (In Russian)

The triple fission, i.e., the fission of a nucleus into 2 heavy fragments and a long-range α particle, represents one of the several decay modes of the excited nucleus. Its probability differs from that of ordinary fission and therefore the dependence of the probability of this event on the neutron energy was determined in the 0.06- to 10-ev range by means of the time-of-flight method with a resolution of 3 μsec/m on the linear accelerator of the I. V. Kurchatov Institute. A system consisting of 7 ionization chambers was used for recording the fission events. The results indicated that the dependence of the triple-fission probability on the energy varies, pointing to a correlation between the probability of the triple fission and the corresponding level widths of the ordinary fission. The experiments also revealed the fact that in addition to the triple fission, the $(n,\alpha)^{235}U$ reaction also emits α particles, as the result of neutron capture at levels possessing a relatively long life. This is in agreement with the available data on the emission of α particles by deformed nuclei (R. Nobles, Phys. Rev. 126: 1508 (1962)). (TTT)

18897 RADIATIVE CAPTURE CROSS SECTIONS OF THE DYSPROSIUM ISOTOPES IN THE 0.023- TO 1-ev RANGE. L. S. Danelyan, Yu. V. Adamchuk, S. S. Moskalev, M. I. Pevzner, and S. S. Yastrebov. At. Energ. (USSR), 16: 56-8(Jan. 1964). (In Russian)

Use of burnable poisons, such as ^{164}Dy, are helpful in extending the range of reactor operations and minimizing reactivity changes connected with the burnup of the fuel. Although the radiative cross section of this isotope which is present in the natural mixture at a concentration of 28.18% is known, the energy dependence of the other isotopes ^{161}Dy, ^{162}Dy, and ^{163}Dy was not previously completely determined. Therefore, the radiative capture cross sections of the Dy isotopes were measured by the time-of-flight method, using a pulsed electron accelerator as the source. The prompt γ radiation emitted by the sample as the result of the (n,γ) reaction was recorded by a scintillation detector. Mass spectrographic analysis showed that less than 0.01% of ^{155}Gd and ^{157}Gd was contained in the samples. The capture cross section of ^{162}Dy in the 0.023- to 1-ev range was due to resonances at 5.44 and 11.3 ev. The curves obtained indicated that ^{161}Dy and ^{163}Dy have levels at a "negative" energy. Tabulations were made also for the capture cross section values for thermal neutrons. (TTT)

18898 THE STRUCTURE OF THE γ-FIELD OF A CESIUM-137 SOURCE. V. A. Vorob'ev. At. Energ. (USSR), 16: 69-70(Jan. 1964). (In Russian)

The angular spectrum function of scattered γ radiation from an infinite, isotropic plane ^{137}Cs source, having an $E_0 = 0.661$ Mev in an air-equivalent medium, was investigated by the Monte Carlo method at distances corresponding to 0.5, 1, and 2 mean free paths (MFP) from it. The surface activity was assumed to be 1 quantum/cm^2 sec. At 0.5 MFP from the source the chief contribution of the scattered radiation was noted at a body angle of about 75°; at 1 MFP the maximum was located at 60°; and at 2 MFP it was found at 0°. At the shortest distance, carrying out the observations under 0°, in the direction of normal, a peak was noted at the 0.3-Mev region in the energy spectrum; this was due to the first-generation γ quanta emitted at about 70°. The integrated spectrum of the plane source was similar to the integrated spectra of point sources in a homogeneous medium. The buildup factors calculated agreed well with the values reported by H. Goldstein. (TTT)

18899 MEASUREMENTS OF GAMMA-RAY ENERGIES FROM Eu^{152} BY THE SCINTILLATION SPECTROSCOPY. Ryusuke Shibata and Rintaro Katano (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 42: 42-7(Jan. 1964).

The scintillation spectroscopic energy determination of some gamma rays from a highly enriched ^{152}Eu source was performed by the use of a 3 inch dia by 3 inch long NaI(Tl) crystal and a 256-channel pulse- height analyzer. The observed channel numbers of the photo-peaks of the rays to be measured were determined as precisely as possible by comparing with those of some standard rays of known energies from calibration sources. The fifteen gamma rays were used as standards. The determined energies of ten rays from ^{152}Eu are (121.9 ± 1.1), (243.6 ± 0.7), (346.6 ± 0.6), (428.7 ± 2.9), (683.9 ± 6.0), (779.1 ± 0.8), (868.2 ± 6.1), (963.9 ± 1.5), (1096.4 ± 1.1), and (1408.9 ± 1.1) kev. The quoted errors are the standard errors derived from a series of measurements using different couples of standard rays for each ray. These gamma rays were concluded to be attributed to the decay of ^{152}Eu. (auth)

18900 EFFECTIVE CROSS SECTION FOR THE INTERACTION OF ANTIPROTONS WITH COMPLEX NUCLEI AT 3 Gev/c. Francoise Bartolin, Bernard Tinland, Albert Bernheim, Brigitte Brami-Depaux, Jacques Bermond, and Vicente Vilar Perez (Centre de Physique Nucleaire, Lyon; Laboratoire de Physique-Enseignement, Paris; Laboratoire de Physique Corpusculaire, Caen, France; and Laboratorie de Physique Nucleaire, Clermont-Ferrand, France). Compt. Rend., 258: 1219-21 (Jan. 27, 1964). (In French)

The interactions and reactions of antiprotons in and with the complex nuclei of photographic emulsion were experimentally studied at 3 Bev/c. The mean free path for the reaction of antiprotons with complex nuclei was determined to be 28.8 cm, with appropriate corrections for meson(π) and (μ) contamination. The effective cross section for the interaction of an antiproton with a bound neutron was estimated to be 112 mb. Within the uncertainties of the nuclear model used, the effective cross section for $\bar{p}$-n is > that for $\bar{p}$-p at 3 Bev/c. (D.C.W.)

18901 ON AN EMPIRICAL REGULARITY IN THE ENERGY SPECTRA OF SOME ODD-MASS NUCLEI. S. M. Brahmavar and M. K. Ramaswamy (Karnatak Univ., Dharwar, India). Current Sci. (India), 32: 497(Nov. 1963).

Previously, a regularity in the level spacing of some odd-A nuclei with 31, 33, and 37 neutrons was pointed out. Now, a similar regularity in the spectra of some odd-mass nuclei with 51, 53, and 55 protons is reported. In these nuclei the level spacing is found to obey the energy sequence given by: $E = n^2E_0$, where n is an integer and E_0 some basic energy value. This regularity is shown by the nuclei of ^{121}Sb, ^{127}I, ^{131}I, ^{131}Cs, and ^{133}Cs. On account of the known spins of these levels, rotational description is ruled out, but the form of the regularity suggests, nevertheless, some form of collective effect in these nuclei. (BBB)

18902 INFLUENCE OF OVERLAP AND EXCHANGE EFFECTS ON FIERZ INTERFERENCE TERM IN GAMOW-TELLER TRANSITIONS. A. S. Venkatesha Murthy and M. K. Ramaswamy (Karnatak Univ., Dharwar, India). Indian J. Pure Appl. Phys., 2: 101(Mar. 1964).

The effect of exchange on the Fierz interference term derived from the K-capture positron branching ratio in ^{22}Na decay was investigated and is shown to be negligible. (auth)

18903 RADIOACTIVE DECAY OF ANTIMONY-124. V. Visweswara Rao, V. Lakshiminarayana and Swami Jnanananda (Andhra Univ., Waltair, India). Indian J. Pure Appl. Phys., 2: 101-3(Mar. 1964).

The decay of antimony-124 was studied employing an electronic summing scintillation spectrometer of the fast-slow type. It was found necessary to introduce levels at 2865, 1900, and 1350 kev. From a study of cascade relations, it was concluded that the 2280 ± 20-kev line, previously reported, is not a transition occurring from the 2865-kev level. On the other hand, the 2280 ± 20-kev line observed in the present study may be taken as a direct transition from the 2295-kev level. Two new gamma transitions, 400 ± 4 and 396 ± 4 kev, were observed between the energy levels 2691-2295 and 2295-1900 kev, respectively. (auth)

18904 ELECTRIC QUADRUPOLE MOMENTS OF STRONGLY EXCITED EVEN-EVEN DEFORMED NUCLEI. B. S. Dzhelepov. Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 2-10(Jan. 1964). (In Russian)

An attempt was made to determine quadrupole moment magnitudes for strongly excited 2^+ states in three even-even nuclei (^{166}Er, ^{168}Er, and ^{190}Os) and 3^+ states in ^{172}Yb. The obtained magnitudes Q_{33}, Q_{22}, Q_{00} lead to a postulation that excited states with excitation energies of 1 Mev are deformed approximately as ground states. (R.V.J.)

18905 INTERACTIONS OF NON-EVAPORATED NUCLEONS IN DEFORMED NUCLEI. V. M. Mikhailov. Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 22-32(Jan. 1964). (In Russian)

Properties of 2-quasiparticle states in deformed nuclei were studied in first-order perturbation theory. In contrast to previous calculations on pair interactions, the calculations are carried out in a cylindrical coordinate system. (R.V.J.)

18906 INELASTIC NEUTRON SCATTERING ON NUCLEI WITH TWO EXTRA NUCLEONS FORMING A GROUND STATE PAIR. B. D. Konstantinov (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 33-40(Jan. 1964). (In Russian)

Inelastic scattering of neutrons on even-even nuclei was studied considering ground state pair correlations. It is assumed that the target consists of an even-even core and a super core with two extra neutrons forming a pair in the singlet S state. A deuteron-type wave function describes the relative neutron pair motion, and the pair energy is used as the neutron bond energy. It is also assumed that a direct two-particle interaction between the incident particle and the pair takes place on the nuclear surface and can be described by a Yukawa potential. The investigation is carried out in Born approximation, such that the transition from the ground state to the excited state is induced by the above interactions. Transition matrix elements are calculated on the basis of these assumptions, and total and differential cross sections for inelastic neutron scattering with pair excitation are found as well as the differential cross section for pair disintegration. (R.V.J.)

18907 ON THE BOUND STATE OF THREE NUCLEONS AND ONE-NUCLEON SCATTERING ON TWO OTHERS IN A BOUND STATE. A. G. Sitenko and V. F. Kharchenko (Khar'kov State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 41-5(Jan. 1964). (In Russian)

The motion of three nucleons was studied under the assumption that the interactions between them are described by a nonlocal potential with separating Yamaguchi variables $(K/V/K') = -(\lambda/M)g(K)g(K')$, where M is the nucleon mass and λ is determined by the condition $\lambda \equiv \Lambda(\alpha)$, $\Lambda^{-1}(\alpha) = \int(g^2(K)/\alpha^2 + K^2)dK$ [(α^2/M) is the energy of the two-nucleon bound state]. Use of this potential for the problem of three nucleon motion reduced it to two integral equations for $S = \frac{1}{2}$ and to one integral equation for $S = \frac{3}{2}$. The equations are uniform for the three-nucleon bound state and non-uniform for a nucleon scattering on two others in a bound state. An analysis was made of the triton-ground state. Experiments on elastic thermal neutron scattering on deuterons show two sets of possible scattering lengths: 1. $a_4 = (6.38 \pm 0.06) \times 10^{-13}$ cm, $a_2 = (0.7 \pm 0.3) \times 10^{-13}$ cm; 2. $a_4 = (2.6 \pm 0.2) \times 10^{-13}$ cm, $a_2 = (8.26 \pm 0.12) \times 10^{-13}$ cm. The scattering lengths calculated assuming nonlocal interactions are in better agreement with the first set of values. Moreover, the squared scattering length, $a_4 = 6.282 \times 10^{-13}$ cm, is in good agreement with the experimental value $a_4 = 6.38 \times 10^{-13}$, while the doublet scattering line $a_2 = -2.756 \times 10^{-13}$ cm, calculated at $\beta_0 = 0.899\beta$, does not agree with the experimental length $a_2 = 0.7 \times 10^{-13}$ cm. (R.V.J.)

18908 INVESTIGATION OF $Al^{27}(p,\alpha)Mg^{24}$ REACTION AT PROTON ENERGY RANGE 1 TO 2.5 Mev. M. A. Abuzeid, F. M. Ali, Yu. P. Antuf'ev, A. T. Baranik, T. M. Nuer, and P. V. Sorokin (Egyptian Atomic Energy Commission, Cairo). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 46-50(Jan. 1964). (In Russian)

Cross sections of $^{27}Al(p,\alpha)^{24}Mg$ and α angular distributions for 13 resonances were measured at proton energies from 1 to 2.5 Mev. An analysis was made of experimental data in order to determine the resonance strengths, spins, and parities for ^{28}Si levels (Ep = 1.184 and 1.363 Mev). (R.V.J.)

18909 $\beta\gamma$-ANGULAR CORRELATION IN Hg^{203} DECAY. Ekbal Bashandi and M. S. El-Nesr (Egyptian Atomic Energy Commission, Cairo). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 51-5(Jan. 1964). (In Russian)

Angular correlations were measured at 5 energies from 50 to 160 kev. It was found that the angular correlation function, including β transition at 207 kev, is in good agreement with ξ approximation theory. The results indicate that β decay is forbidden and has a resolved shape. Log ft = 6.4 classifies the first forbidden transition. (R.V.J.)

18910 GEOMETRIC EFFECT IN STRIPPING REACTIONS ON DEFORMED NUCLEI. V. K. Luk'yanov and

A. G. Fokin (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 56-9(Jan. 1964). (In Russian)

Previously it was shown that stripping reactions on deformed nuclei excited single-particle and rotational states. Considerations for rotational nuclei (axial and nonaxial) resulted in a supplementary selection rule that altered the angular distribution of the reaction products and affected the total level width due to additional overlap of rotational wave functions for the initial and final nuclei. Geometrical corrections were made for the relative widths of rotational states of ^{24}Mg in ^{25}Mg(d,t) reactions. Tabulated data showed that the geometrical corrections were quite small; only in the case $2^{+}{}_{7}$ did they comprise ~ 20%. It was also shown that within the limits of one variable the theoretical and experimental data do not agree. Thus, either the postulation on the conservation of moments in external nucleons in odd nuclei does not hold or the rotational model for nuclei with A ~ 25 should be verified. (R.V.J.)

18911 MEASUREMENTS OF CONVERSION TRANSITION COEFFICIENTS AT 1059.0 kev IN Lu^{172} DECAY. CALCULATIONS OF TRANSITION PROBABILITIES BETWEEN K = 3^{--} AND K = 0^{--}. B. S. Dzhelepov, A. I. Medvedev, I. F. Uchevatkin, and S. A. Shestopalova (All-Union Research Inst. of Meteorology, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 64-71(Jan. 1964). (In Russian)

Transitions at 1095.0 and 913.8 kev taking place between the K = I′ = 3^{+} and K = 0, I = 2^{+} and 4^{+} in ^{172}Lu decay were investigated. The true multiplicity for 1095.0 kev was determined by measuring K-shell conversion coefficients and using a direct comparison of γ and internal conversion intensities for ^{172}Lu and ^{60}Co and ^{46}Sc pure E2 transitions. A scintillation spectrometer was used for measuring γ intensities and a double-focusing β spectrometer was used for conversion lines. The conversion coefficient for ^{60}Co was found to be $(2.8 \pm 0.4) \times 10^{-3}$ and for ^{46}Sc, $(2.67 \pm 0.15) \times 10^{-3}$. These magnitudes are in agreement with theoretical pure E2 transitions and do not contradict a mixed E2 + M1 (to 12% M1). New data initiated an experiment for determining the multiplicity $3^{+} \rightarrow 2^{+}$ (1095.0 kev) ^{172}Yb. The composition is 95% E2 + 5^{+}_{-4}% M1. The ratio of K conversion intensities is (K913.0/K1095.0) = 0.40 0.02. Further studies produced $Q'_{20} = (3.50 \pm 0.10) \times 10^{-3}$ b and $Q''_{20} = (0.16 \pm 0.04) \times 10^{-3}$ b. (R.V.J.)

18912 CONVERSION ELECTRON SPECTRA OF Pd FRACTION (AT LOW ENERGIES). I. M. Rogachev and M. K. Nikitin. Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 72-5 (Jan. 1964). (In Russian)

A magnetic lens β spectrometer with intermediate acceleration was used for measuring Pd electron spectra at 100 kev. The relative half-width for the conversion line K 83.8 (E_e = 60.6 kev) was 2.3%. A Geiger counter with a 0.13-μ aluminum oxide window recorded electron spectra from 2 kev and up. A table of 12 lines for low energy conversion and Auger electrons shows that for the examined lines the $T_{1/2}$ is 4.5 to 5.2 days and 18 days. The 36.15- and 38.87-kev electrons belong to ^{103}Pd decay and correspond to α and (M + N) shell in ^{103}Ru ($T_{1/2}$ = 17.5 ± 0.5 days). The obtained data indicate that 32.3-, 74.4-, and 83.8-kev transitions belong to Pd decay. The half lives of γ transitions are considered to belong to ^{100}Pd, which converts into odd-odd ^{100}Rh. The odd-odd ^{104}Ag nucleus, differing from ^{100}Rh by 2 protons and 2 neutrons, has 83.6- and 66.7-kev transitions. (R.V.J.)

18913 ON THE γ-TRANSITIONS OF $In^{116} \rightarrow Sn^{116}$ IN THE HIGH-ENERGY REGION. S. V. Starodubtsev, R. B. Begzhanov, and S. L. Rakovitskii (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 76-9(Jan. 1964). (In Russian)

A double-focusing $\pi\sqrt{2}$ β spectrometer with 25% resolving power was used for measuring K- and α-shell internal conversion coefficients for high-energy ^{116}Sn γ transitions of 1100, 1296, 1511, 1760, and 2121 kev. The results of γ-transition multiplicity determination showed that for 1100, 1296, and 1511 kev the multiplicity is E2; for 1760 kev the multiplicity is M2 when the quantum characteristic of the 3056-kev level is 5^{+} or has a mixed E2 + M3 character; and for 2121 kev the multiplicity was assumed to be E2 with a negligible M1 admixture. The data were used to estimate the higher ^{116}I excitation levels. (R.V.J.)

18914 HALF LIVES OF W^{182}, Pr^{144}, AND Eu^{151} LEVELS. E. E. Berlovich, Yu. K. Gusev, D. M. Khai, and Shenakh (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 80-7(Jan. 1964). (In Russian)

Lifetimes of ^{182}W at 100.1 and 1289.7 kev, ^{144}Pr at 100 kev, and ^{151}Eu at 21.7 kev were studied using ^{182}Ta, ^{144}Ce, and ^{151}Gd. Decay curves for ^{182}W (100.1 and 1289.7 kev) showed $T_{1/2} = (1.4 \pm 0.1) \times 10^{-9}$ sec and $(1.05 \pm 0.05) \times 10^{-9}$ sec, respectively; for ^{144}Pr (99.95 kev), $T_{1/2} = (0.95 \pm 0.08) \times 10^{-9}$ sec; and for ^{151}Eu (21.7 kev), $T_{1/2} = (7.2 \pm 0.7) \times 10^{-9}$ sec. The results are analyzed and compared with published data. (R.V.J.)

18915 HALF-LIFE OF Te^{125} FIRST EXCITATION STATE. I. N. Rozantsev (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 88-9(Jan. 1964). (In Russian)

The half life of the ^{125}Te first excitation level (35.5 kev) was found to be 1.32 ± 0.21 nsec. The result is in agreement with data obtained from x-ray coincidence, α-shell conversion electrons, and γ resonance scattering. (R.V.J.)

18916 ON THE Tb^{149} DECAY SCHEME. A. S. Danagulyan, A. T. Strigachev, and V. S. Shpinel (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 90-2(Jan. 1964). (In Russian)

A constant-field spectrograph with photorecording and 0.08% resolving power was used for studying conversion line spectra for ^{149}Tb and ^{150}Tb. Twenty-one γ transitions were identified. Transitions at 165, 187, and 352 kev in ^{149}Tb and 637 kev in ^{150}Tb were used for developing a ^{149}Tb decay scheme. (R.V.J.)

18917 ON Rh^{104*} DECAY ($T^{1}/_{2}$ = 4.4 MIN). I. V. Estulin, L. F. Kalinkin, and A. S. Melioranskii (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 93-7(Jan. 1964). (In Russian)

A scintillation coincidence spectrometer was used for measuring x and γ emissions and γ-γ coincidence in ^{104*}Rh. A porus 22-mg rhodium specimen pressed into an aluminum foil was irradiated with ~10^{8} n/cm^{2} · sec for 2 to 10 min. Measurements on the 4.4-min ^{104}Rh activity revealed a 97.1-kev γ-quantum, indicating a transition at 31.9 kev. The obtained data allowed a quantitative determination of the ratio between conversion coefficients and γ-transition intensities. The coincidence spectra showed, in addition to 20 and 51 kev intensities, some maxima at 77 and 97 kev; indicating that the 31.9-kev K shell transition is relatively large. The measurements resulted in the development of 10 independent equations, with the internal conversion coefficients (α_k, $1 + \alpha$, $\alpha_k/1 + \alpha$) acting as unknown functions, for γ transitions and intensities. (R.V.J.)

18918 INVESTIGATION OF Pt^{189} AND Ir^{189} DECAY SCHEMES BY $e\gamma$-COINCIDENCE. L. N. Kryukova, V. V. Murav'eva, N. V. Forafontov, B. A. Khotin (Moscow State

Univ. and Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 98-101(Jan. 1964). (In Russian)

Decay schemes of ^{189}Pt ($T_{½}$ = 11 hrs) and its daughter product, ^{189}Ir, produced by 660-Mev proton spallation of gold were studied by e-γ coincidence. A double-lens spectrometer with 3% resolving power was used for measuring platinum conversion electrons to 170 kev. The e-γ coincidences with conversion electrons (K113, L71, K140, L81, and L94) of ^{189}Pt were measured. Coincidence spectra for K113 and L94 are included. The e-γ coincidence measurements were made with iridium sources in order to confirm γ cascades belonging to platinum. A decay scheme for ^{189}Os was constructed on the basis of γ transitions for ^{189}Ir ($T_{½}$ = 11 days). (R.V.J.)

18919 DETERMINATION OF K-FLUORESCENCE AND K X-RAY SELF-ABSORPTION COEFFICIENTS FOR Mg AND Al. A. A. Konstantinov, V. V. Perepelkin, and T. E. Sazonova. Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 107-14(Jan. 1964). (In Russian)

K-fluorescence yields for Mg and Al were determined using a 4π proportional counter and absolute K x-ray counting. Electron capture in ^{51}Cr(^{51}V) and ^{54}Mn(^{54}Cr) was used for exciting K x-rays or K-fluorescence. The resolving power of the counter for ^{54}Cr(^{54}Mn) and ^{51}V(^{51}Cr) was 18 and 20%, respectively. Data on K-fluorescence self-absorption are tabulated. Fluorescence yields were 2.80 ± 0.11 and 3.81 ± 0.15 for Mg and Al, respectively. The order of error did not exceed 4%. KX self-absorption magnitudes were 440 and 390. (R.V.J.)

18920 ON VIBRATIONS OF NON-SPHERICAL NUCLEI. D. F. Zaretskii and M. G. Urin. Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 118-26(Jan. 1964). (In Russian)

A semiclassical method similar to the cranking model was used in studies of vibration levels in non-spherical nuclei. In this aspect the analysis is macroscopic. A Green's function formalism with automatically satisfied continuity was used for expressing superfluid nuclear states. The dispersion equation for collective excitation frequencies, developed by means of Green's one-dimensional function, differs from previously obtained equations in that the latter method, using approximate secondary quantization with simple canonical Bogolyubov transposition, did not satisfy continuity. Collective excitations investigated macroscopically were interpreted as oscillations of total multipole nuclear mass moments. Such moments result from nuclear surface deformation and nucleon density redistribution. Separation into surface and volume oscillations is possible only when the pair correlation radius is much smaller than the nuclear dimensions (hydrodynamic maximum). Identical results could be obtained for spherical nuclei. (R.V.J.)

18921 ANHARMONIC OSCILLATIONS OF SPHERICAL NUCLEI. S. T. Belyaev and V. G. Zelevinskii. Izv. Akad. Nauk SSSR, Ser. Fiz., 28: 127-32(Jan. 1964). (In Russian)

A series of phenomenological models using a definite number of parameters have been suggested for studying empirical vibration spectra of spherical nuclei. The simplest model of quadrupole harmonic oscillations predicts an equidistant spectrum consisting of degenerate multiplicities (as in the case in which the second level is a triplet 0^+, 2^+, and 4^+). According to such a model, E2 transition is possible between levels belonging to neighboring multiplicities (the number of phonons changes to one) and $B(E2; 22 \rightarrow 21)/B(E2; 21 \rightarrow 0) = 2$. Real nuclei have spectra differing from those predicted by the harmonic model. An attempt was made to describe the differences using anharmonic corrections in phonon interactions (or the contrasting of a pair of bound quasiparticles in a nucleus with an ideal Bose excitation). After separating the main anharmonic corrections the problem permits a phenomenological approach by introducing two parameters (bond constants in three- and four-phonon hamiltonians) for each nucleus and by using them for calculating level energies, wave functions, and transition probabilities. Phenomenological anharmonic parameters and the ratio of E2 transition probabilities for various nuclei are tabulated. (R.V.J.)

18922 ON Sn^{116} γ TRANSITION MULTIPLICITY IN In^{116m} 54 MIN. β DECAY. S. V. Starodubtsev, R. B. Bezzhanov, and S. L. Rakovitskii. Izv. Akad. Nauk Uz. SSR, Ser. Fiz.-Mat. Nauk, No. 5, 40-4(1963). (In Russian)

Internal conversion in ^{116}Sn and ^{116}In high-energy γ transitions was measured, and the 54-min. decay scheme for ^{116m}In was developed. Measurements were carried out with a double-focusing $\pi\sqrt{2}$ β spectrometer with a resolving power of 0.2%. Energy magnitudes for ^{116}Sn γ transitions, determined by K- and L-shell conversion electron energy, are compared with published data. Experimental data for K-shell internal conversion and theoretical values for various multiplicities showed that the 1.296-Mev transition is pure E2 between 2^+ and 0^+. Angular moments and parities for the higher ^{116}Sn levels were determined. I = 4 and π = 4 are the most probable magnitudes for the 2807-kev level. (R.V.J.)

18923 LIFETIME OF Sn^{116} AT 1.29 Mev. R. B. Bergzhanov, D. K. Kaipov, Yu. K. Shubnyi, and A. A. Islamov. Izv. Akad. Nauk Uz. SSR, Ser. Fiz.-Mat. Nauk, No. 5, 45-50(1963). (In Russian)

The half life of the first excitation state of ^{116}Sn at 1.29 Mev was determined using γ resonance scattering. A 54-min ^{116m}In source was used to obtain levels in ^{116}Sn at 3.07, 2.82, 2.54, and 2.41 Mev. Calculations of incident quantum, $N(E_p)$, distribution by energies were made for $\beta-\gamma$ and $\beta-\gamma-\gamma$ cascades resulting in the 1.29-Mev level. The τ_γ time determined by self-absorption is shorter than that indicated by scattering, indicating a considerable influence of chemical bonding. The upper-limit magnitudes for $N(E_p)$ and the half life of the first excited state are 0.0127 kev^{-1} and 1.81×10^{-13} sec. The value 0.0044 ev^{-1} for $N(E_p)$ corresponds to $\tau_\gamma = 6.4 \times 10^{-13}$ sec. Calculations of τ_γ by the single particle model yield a value of 6.6×10^{-12} sec. Thus the E2 transition at 1.29 Mev is accelerated by a factor of 10.5, indicating a collective character for the first ^{116}Sn level. (R.V.J.)

18924 CROSS SECTIONS FOR THE (n,p) REACTION ON ^{46}Ti, ^{48}Ti, AND ^{50}Ti. D. R. Koehler and W. L. Alford (Army Missile Command, Redstone Arsenal, Ala.). J. Nucl. Energy, Pt. A & B, 18: 81-2(Feb. 1964).

Activation techniques were used to determine the relative cross sections for the (n,p) reaction on ^{46}Ti, ^{48}Ti, and ^{50}Ti at 14.7 ± 0.7 Mev. (C.E.S.)

18925 ANGULAR CORRELATION OF ELECTRONS IN INTERNAL CONVERSION PAIRS. M. Jean Yoccoz (Faculté des Sciences, Strasbourg). J. Phys. (Paris), 24: 1095-6(Dec. 1963). (In French)

The angular correlation between electrons of nuclear pairs is calculated for the general case of polarized emitting nuclei. It is shown that the correlation is sensitive only to the statistical tensors of even order. (auth)

18926 STUDY OF THE HYPERFINE STRUCTURES OF ARC LINES OF Tm^{169}. Y. Bordarier, R. Vetter, and J. Blaise (CNRS, Bellevue, France). J. Phys. (Paris), 24: 1107-12(Dec. 1963). (In French)

The hyperfine structures of 70 lines of the Tm I spec-

trum were studied using a Hypeac photoelectric spectrometer. Energies, hyperfine splittings, and J-values were determined for 27 levels, and 58 lines were classified. The hyperfine splitting of the ground state was measured accurately: $\delta W = -49.5$ mK. The energy and hyperfine splitting of lower levels in the $4f^{12}6s7s$ configuration were calculated. (auth)

18927 THE 0^+ LEVELS OF O^{16}. Yvon Abgrall (CNRS, Strasbourg). J. Phys. (Paris), 24: 1113-17(Dec. 1963). (In French)

The 0^+ levels in ^{16}O are studied in terms of the shell model with zero-range nuclear forces. All the 0^+ levels are described as a mixture of the closed shell configuration and configurations with $2\hbar\omega$ unperturbed energies. The spurious states are eliminated, and the energy matrix is diagonalized. The interference between the ground state and the first excited state correctly explains the monopole matrix element and the ratio of the transition probabilities from the first 1-T = 1 level to these two levels. For the excitation energies, the agreement is not very good. (auth)

18928 DETERMINATION OF THE NEUTRON REACTION CROSS SECTION FOR THE RHODIUM-103 NUCLEUS. Gyula Csikai, József Bacsó, and Sándor Daroczy (Nuclear Research Inst., Debrecen, Hungary). Magy. Fiz. Folyoirat, 11: 7-17(1963). (In Hungarian)

The $^{103}Rh + n$ reaction was examined and the energy dependence of the cross section of the isomeric pair formed by the $^{103}Rh(n,\gamma)^{104,104m}Rh$ reaction was studied together with the behavior of the impulse moment of the intermediate nucleus formed during transition to lower spin levels. It was assumed that the decay of the intermediate nucleus by γ emission may be neglected if another particle channel is open. Activation by neutrons at 0.032 ev, 24 and 116 kev, and 2.49 and 14.67 Mev was used for the measurements; a Sb–Be system in a paraffin block served as the photoneutron source in the thermal-neutron activation experiments. The measured half life of the isomer pair $^{104,104m}Rh$ obtained in the tests agreed well with the literature data. The following average half life values were found: ^{104}Rh, (42.8 ± 0.47) sec; ^{104m}Rh, (4.29 ± 0.05) min; and ^{100}Tc, (17.11 ± 0.72) sec. The total (n,γ) cross sections at 24 kev was $\sigma_g = 1.69$ b and $\delta_{n\gamma} = 1.89$ b. At 2.49 Mev, a value of 5.24 was obtained for the $\delta_{n\gamma}/\delta_{n\alpha}$ ratio. The absolute reaction cross sections at a neutron energy of 14.67 Mev were as follows: $^{103}Rh(n,\gamma)^{104}Rh$, 10.57 mb; $^{103}Rh(n,\gamma)^{104m}Rh$, 3.23 mb; and $^{103}Rh(n,\alpha)^{100}Tc$, 11.16 mb. (TTT)

18929 γ-TRANSITIONS IN THE Z = N TYPE EVEN-EVEN NUCLEI. Lajos Keszthelyi (Central Physics Research Inst., Budapest). Magy. Fiz. Folyoirat, 11: 21-68 (1963). (In Hungarian)

Examination of γ rays emitted by or interacting with excited nuclei yields valuable information on the energy, spin, parity, isotopic spin, and in some cases on the magnetic and quadrupole moment of the excited state; the γ transition probability also reveals the inner structure of the nucleus. Certain γ-transfer characteristics of N = Z even-even light nuclei, with Z < 30, were reviewed for the case of ^{12}C, ^{16}O, and ^{20}Ne. A Cockcroft-Walton generator was used in the experiments; known nuclear reaction resonances were employed for the calibration of the accelerating system. It was found that the E2 transition of ^{12}C from the 16.1-Mev excited state to the ground state has a width of 7.6 ± 1.9 ev while the 11.67-Mev M1 transition leading to the 4.43-Mev first excitation level has a width of 220 ± 60 ev. The 17.55-Mev level of ^{16}O was examined; the existence of this level was substantiated. It was concluded, in disagreement with the findings of A. S. Penfold and B. M. Spicer (Phys. Rev., 100: 1377(1955)), that the level width must exceed 150 kev. For the 13.086-Mev level of ^{20}Ne, the spin and parity were found to be 2-. A study of the $^{19}F(p,\alpha,\gamma)$ reaction revealed that its probability is smaller by a factor of at least 6×10^{-5} than that of the $^{19}F(p,\gamma)^{20}Ne$ reaction. In connection with these studies, the $Li(p,\gamma)^8Be$ and the $^{121}Sb(\gamma,n)^{120}Sb$ reactions were also examined. (TTT)

18930 INTERNAL BREMSSTRAHLUNG IN THE CASE OF ELECTRON CAPTURE. Dénes Berényi (Nuclear Research Inst., Debrecen, Hungary). Magy. Fiz. Folyoirat, 11: 295-303(1963). (In Hungarian)

The intensity of the internal bremsstrahlung is a quadratic function of the total decay energy; in the case of ^{55}Fe about 3×10^{-5} internal bremsstrahlung quantum is emitted for each decay event. If the Z of the emitting nucleus is low and the decay energy is high, the shape of the spectrum is determined by the "s-spectrum." The theory developed by R. J. Glauber and P. C. Martin (Phys. Rev., 104: 158 (1956); 109: 1307(1958)) provides a satisfactory explanation for the obtained spectra. Additional studies are needed to explain the transition energies in some specific case, e.g., for ^{59}Co and ^{113}Sn. No experimental data were available on the correlation between the internal bremsstrahlung and the subsequent γ radiation and on the angular distribution of the bremsstrahlung of oriented nuclei decaying by electron capture. NaI scintillation crystals with a multiplier and multichannel analyzer were used for experiments in this field; if the electron capture was followed by γ radiation, a second scintillation counter and a coincidence circuit were used. In addition, for the usual correction for background and dead time of the system, Compton scattering detector efficiency changes and resolving power of the system, together with absorption in the material between the source and the detector must be taken into account. (Review article, 59 references). (TTT)

18931 THEORY, MEASUREMENT AND MEANING OF THE ELECTRON CAPTURE–POSITRON EMISSION RATIO. Dénes Berényi (Nuclear Research Inst., Debrecen, Hungary). Magy. Fiz. Folyoirat, 11: 431-44(1963). (In Hungarian)

From measurements of the specific properties of nuclear levels, the processes responsible for parity change and for the difference of impulse moments of the initial and final states can be determined. The importance of these phenomena in radioactive decay were examined. The review includes discussions of the following phenomena: β transitions, shape of the β spectrum, lifetime of the nuclear levels, internal conversions, angular correlations, orientation of the nucleus, branching relations of γ radiation, internal bremsstrahlung, intensity of the electron capture ratio at various levels (L/K ratio), and the ϵ/β^+ ratio. The methods employed may be used for both the β^+ and the β^- decay of radioactive nuclei. Whenever the energy relations allow it, appearance of the positrons is always expected in the decay of radioactive materials but the relative number of positrons depends on the order number of the decaying nuclide, the magnitude of the total decay energy, and the value of the forbidden transitions. Determination of the ϵ/β^+ ratio is of importance not only to clarify the given decay scheme but also for checking the validity of the β decay theory and the wave function of atomic electrons and for establishing the forbidden character of a transition when the shape of the spectrum cannot be examined. (Review articles, 34 references). (TTT)

18932 PROPOSAL FOR EXPERIMENTAL DETERMINATION OF INCOHERENT INELASTIC NEUTRON SCATTERING. L. Guttman (Argonne National Lab., Ill.). Nucl. Instr. Methods, 25: 188(Dec. 1963).

Conditions are described under which the coherent and incoherent contributions to inelastic neutron scattering can be unambiguously separated. Experimental implementation of this idea is discussed. (T.F.H.)

18933 NEUTRON PRODUCTION BY 450-Mev PROTONS. J. W. Meadows, G. R. Ringo, and A. B. Smith (Argonne National Lab., Ill.). Nucl. Instr. Methods, 25: 349-52(Jan. 1964).

Measurements on neutron production in U, Pb, Al, and D_2O targets inside an hydrogenous moderator have been made with a beam extracted from the University of Chicago cyclotron. With targets 10 cm in diameter and 15 cm thick, U gave 5.7 ± 1.4 neutrons per proton and a maximum flux in the moderator of about 0.012 ± 0.002 neutrons cm^{-2} $proton^{-1}$; Pb gave about one-half as much and Al and D_2O much less. (auth)

18934 PHENOMENOLOGICAL DISCUSSION OF EQUILIBRIUM SHAPE OF DEFORMED NUCLEI. Toshimitsu Yamazaki (Tokyo Univ.). Nucl. Phys., 49: 1-14(Nov. 1963).

In general the predictions of the Bohr-Mottelson model can be replaced by those of the asymmetric-rotor model for the K = 2 band. Since any difference between the predictions of the two models is not inherent to the assumption on the equilibrium shape or gamma vibration, it is impossible to distinguish between these models by predicted quantities such as these. However, the two models give quite different features for higher band schemes. Experimental information about the K = 4 band seems to provide evidence for the validity of the Bohr-Mottelson model in contrast to the asymmetric-rotor model. (auth)

18935 ON THE BINDING AND SCATTERING OF THE THREE-NUCLEON SYSTEM. A. G. Sitenko and V. F. Kharchenko (Kiev Inst. for Physics, Ukrainian SSR). Nucl. Phys., 49: 15-28(Nov. 1963).

The problem of the motion of three nucleons, the interaction between which is described by the Yamaguchi nonlocal potential, is considered. The Schroedinger equation is reduced to a set of integral equations for the space functions of different symmetry. The kernels of the integral equations are expressed through the two-particle scattering matrix. If the interaction between nucleons is taken only in the S-state the integral equations are one-dimensional. The cases of the total spin of the system S = ½ and S = ³/₂ (T = ½) are considered. The numerical solution of the integral equations yields the binding energy and wave function of the bound state of three nucleons as well as the quartet and doublet scattering lengths of zero energy neutrons by deuterons. (auth)

18936 HALF-LIVES OF EXCITED STATES IN SOME ODD-MASS NUCLEI. I. M. Govil and C. S. Khurana (Muslim Univ., Aligarh, India). Nucl. Phys., 49: 29-32(Nov. 1963).

The half lives of the following excited states were measured by the delayed coincidence technique using a time-to-pulse-height converter: the 57 kev level in ^{143}Pr, $T_{½}$ = (5.8 ± 0.15) nsec; the 123 kev level in ^{131}Cs, $T_{½}$ = (4.1 ± 0.11) nsec; the 136 kev level in ^{159}Tb, $T_{½} \leqq (9 \pm 1) \times 10^{-10}$ sec; the 480 kev level in ^{181}Ta, $T_{½}$ = (10.5 ± 0.5) nsec. (auth)

18937 DISPERSION THEORY AND THE NUCLEAR MANY-BODY PROBLEM. R. J. Eden and J. Goldstone (Cambridge Univ., Eng.). Nucl. Phys., 49: 33-43(Nov. 1963).

The equations of the nuclear many-body problem are formulated so that the analyticity properties required by dispersion theory are retained in each approximation. In particular the vertex parts for photon or nucleon absorption by a nucleus will have the analyticity expected from dispersion theory provided the nucleon-nucleon interaction has the usual analytic properties. By summation of diagrams in relativistic dispersion theory a closed scheme of self-consistent equations is obtained for vertex parts involving a nucleus. The non-relativistic approximations are described, which relate this scheme to the usual self-consistent equations for nuclear wave functions. (auth)

18938 ON THE THEORY OF NUCLEAR REACTIONS. G. M. Vagradov (Lebedev Inst. of Physics, Moscow). Nucl. Phys., 49: 44-54(Nov. 1963).

The collision of a non-relativistic nucleon with a nucleus is considered in the second quantization representation, the Hamiltonian of the system containing the nucleon-nucleon interaction potentials. The formulas for the optical potential, the scattering amplitudes, and the reactions are obtained. It is shown that these amplitudes can be represented as a sum of two parts, one of which has a resonance character and corresponds to the compound nucleus mechanism. The optical potential parameters are calculated in the statistical model of the nucleus with realistic pair forces between the nucleons. (auth)

18939 LEVEL SCHEME OF Ga^{69}. C. F. Schwerdtfeger, A. V. Ramayya, and Allan C. G. Mitchell (Indiana Univ., Bloomington). Nucl. Phys., 49: 55-64(Nov. 1963).

The decay of ^{69}Ge (38.5 ± 0.5 h) to levels in ^{69}Ga was investigated with scintillation spectrometers and coincidence techniques. Transitions were found to depopulate levels at 323, 576, 880, 1120, 1346, 1560, 1880, 1910, 1945 and 2040 kev. A source of ^{69}Zn was also investigated but no new transitions were observed. A decay scheme consistent with the experimental data is presented. (auth)

18940 SCATTERING AND STRIPPING OF DEUTERONS ON He^4 BETWEEN 21 AND 28 Mev. H. J. Erramuspe and R. J. Slobodrian (Comision Nacional de Energia Atomica, Buenos Aires). Nucl. Phys., 49: 65-75(Nov. 1963).

The angular distributions of elastically scattered deuterons on ^4He were measured at 21.3, 24.3, 25.8, and 27.3 Mev. At 21.3 Mev the shape is qualitatively consistent with some lower energy measurements. Between 24.3 and 27.3 Mev an additional oscillation in the elastic differential cross section is presumably related to the appearance of an F component used elsewhere to fit data at lower energies. The angular distribution of the stripping reaction $^4He(d,p)^5He$ was also measured at 24.3 and 27.3 Mev. The residual nucleus is left in a virtual ground state and is very short lived. The proton group seems to be the "head" of a continuum of the three body deuteron break up process. Some indications of an oscillatory behavior of the differential cross section were obtained. Some reasonable PWBA fits were calculated for $l_n = 1$ and for the strikingly small interaction radii, $r_0 = 1.2$ fm at 27.3 Mev and $r_0 = 1.3$ fm at 24.3 Mev. The corresponding reduced widths are $\theta^2 = 0.0031$ and $\theta^2 = 0.0033$, respectively. (auth)

18941 CONNECTION OF SCATTERING CROSS SECTIONS WITH COLLECTIVE CHARACTERISTICS OF SCATTERING NUCLEI. V. I. Belyak (Lebedev Inst. of Physics, Moscow). Nucl. Phys., 49: 76-86(Nov. 1963).

Connection is established between the scattering cross sections and the characteristics of the scattering nuclei (reduced probabilities for electric transitions and quadrupole moment) in the approximation linear with respect to the deformation of the nucleus. The regions of applicability of this approximation are indicated. The problem of scattering with excitation of the second 2^+ level of even nuclei is considered. (auth)

18942 SPIN-ORBIT INTERACTION IN DEFORMED NUCLEI. V. A. Chepurnov and P. E. Nemirovskii (Nemirovsky) (Kurchatov Atomic Energy Inst., Moscow). Nucl. Phys., 49: 90-6(Nov. 1963).

The spin-orbit interaction of a particle in a non-central self-consistent field of the Woods-Saxon type is investigated for light nuclei. It is shown that in the expansion of the wave function in l-waves the particle states of orbital momentum $l_{max}+2$ of the shell considered are essential. The scheme of single-particle states is calculated for A = 10 and 25. A satisfactory agreement with experiment is obtained for ^{25}Mg and ^{29}Si. (auth)

18943 GEOMETRICAL POSITIONS OF NUCLEON CLUSTERS IN THE NUCLEUS. S. Matthies, V. G. Neudachin, and Yu. F. Smirnov (Moscow State Univ.). Nucl. Phys., 49: 97-107(Nov. 1963).

The method of directed orbitals known in quantum chemistry is used to formulate some general rules for determining the geometrical positions of α-clusters in a nucleus by a given set of Nilsson orbits or by shell configuration. As illustration certain excited states of ^{16}O and ^{12}C are considered, and the geometry of the position of α-clusters in ^{40}Ca is determined. Several critical remarks are made on the application of the α-model to light nuclei; the α-model is erroneous in the description of ^{16}O. (auth)

18944 THE IDENTIFICATION OF A DOUBLE HYPERFRAGMENT. M. Danysz (Univ. of Warsaw), K. Garbowska, J. Pniewski, et al. Nucl. Phys., 49: 121-32(Nov. 1963).

The detailed analysis is presented of an event which is interpreted as the mesonic cascade decay of a double hyperfragment produced by the capture of a Ξ^- hyperon on a light emulsion nucleus. The most likely interpretations of the double hyperfragment are those in terms of either $^{10}_{\Lambda\Lambda}$Be or $^{11}_{\Lambda\Lambda}$Be. (auth)

18945 GYROMAGNETIC RATIO OF 206 kev LEVEL IN Re^{187}. S. Koički, A. Koički, and G. T. Wood (Univ. of Pennsylvania, Philadelphia). Nucl. Phys., 49: 161-9(Nov. 1963).

The nuclear g-factor of the 530 ns 206 kev state in ^{187}Re was measured by the differential angular correlation method. Its value is 1.046 ± 0.03. The source was a water solution of neutron irradiated Li_2WO_4. The measurements of the time differential anisotropy of the 479-72 kev γ-γ cascade were made over a 1.3 μs time interval without observable attenuation of the angular correlation. The average quadrupole interaction frequency ν_Q is less than 180 MHz assuming a liquid correlation time of 10^{-11} sec. Appreciable attenuation of the differential anisotropy was observed for sources prepared from irradiated tungsten metal dissolved in a HF + NHO_3 acid mixture. The angular correlations of the 552-134 kev and 72-134 kev γ-γ cascades in ^{187}Re were found to be isotropic. A measurement of the half life of the 206 kev state yielded a value of 557 ± 12 ns. (auth)

18946 BETA DECAY THEORY USING EXACT ELECTRON RADIAL WAVE FUNCTIONS. [PART] II. Wolfgang Buehring (Universität, Heidelberg). Nucl. Phys., 49: 190-208(Nov. 1963).

The $1^- \rightarrow 0^+$ negaton decay of RaE, the $0^- \rightarrow 0^+$ negaton decay of ^{204}Tl, and the $0^+ \rightarrow 0^+$ positon decay of ^{66}Ga are discussed as an application of beta decay formulas derived in a previous paper. In these cases it is essential to use formulae which are free from the usual approximations. On the basis of the previous work formulas for the general n-th forbidden spectrum shape factors are presented. (auth)

18947 A STUDY OF THE $Be^9(p,\alpha)Li^6$ REACTION FROM 3.5 TO 12.5 Mev. H. R. Blieden (Florida State Univ., Tallahassee and Universitet, Copenhagen), G. M. Temmer and K. L. Warsh. Nucl. Phys., 49: 209-38(Nov. 1963).

Angular distributions and excitation curves for the ^{9}Be(p,α_0)^{6}Li and ^{9}Be(p,α_1)^{6*}Li (2.18 Mev) reactions have been measured for proton bombarding energies from 3.50 to 12.50 Mev. Total cross sections for α_0 and α_1 as well as 90° (lab) yields are monotonically decreasing functions of energy, and the angular distributions show very little change with energy. These data suggest that the reaction is predominantly a direct process over the energy interval studied. No prominent resonance behavior is observed in the energy interval corresponding to excitation energies in ^{10}B from 9.3 to 17.8 Mev. In order to perform a consistent distorted-wave Born approximation (DWBA) calculation of the reaction, elastic scattering experiments in the entrance and exit channels were performed. At the same time data were obtained on several other reactions, namely ^{9}Be(p,d)^{8}Be, ^{9}Be(p,p')^{9*}Be (2.43 Mev), ^{6}Li(α,α')^{6*}Li (2.18 Mev) and ^{6}Li(α,d)^{8}Be. Optical model parameters for the zero-range DWBA calculation of ^{9}Be(p,α)^{6}Li were obtained by analyzing the elastic scattering data. Results of the calculation based on the triton pick-up process give fairly good agreement with the data for α_0, but not for α_1. These results are compared to plane wave calculations. The possibility of interpreting the data in terms of exchange processes is also discussed, as well as the applicability of the DWBA calculation to this reaction. (auth)

18948 GAMMA TRANSITIONS IN THE DECAY OF V^{52}. S. Malmskog (Aktiebolaget Atomenergi, Studsvik, Nykoping, Sweden). Nucl. Phys., 49: 239-50(Nov. 1963).

A fast-slow coincidence set-up with a time resolution of 3 ns (at 1 Mev) was constructed using a time to pulse-height converter as the fast coincidence unit. This instrumentation, which is transistorized throughout, was used in the search for weak gamma transitions following the decay of ^{52}V (3.8 min). Three new transitions of 1.21 Mev (0.29 ± 0.06%), 1.53 Mev (0.53 ± 0.04%) and 1.73 Mev (<0.05%) were found. A gamma-gamma angular correlation study on the 1.43 Mev-1.53 Mev cascade is consistent with a 2^+(E2 + M1) 2^+(E2)0^+ cascade with a large M1 component (>90%). (auth)

18949 PROTON CAPTURE GAMMA RAYS IN THE GIANT RESONANCE REGION OF Mg^{24}. H. E. Gove (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Phys., 49: 279-85(Nov. 1963).

The reaction ^{23}Na(p,γ)^{24}Mg was investigated in the proton energy range from 3.8 to 11.6 Mev, and the yield of gamma rays leading to the ground state was separated from that to the first excited state at 1.37 Mev. The ground state yield is compared to that predicted by current theories for the E1 giant resonance in deformed nuclei. (auth)

18950 CLASSIFICATION OF QUANTITIES DETERMINED BY POLARIZATION MEASUREMENTS IN (d,n) REACTIONS. R. Botzian (Technische Hochschule, Aachen). Nucl. Phys., 49: 289-99(Nov. 1963).

For a (d,n) reaction, the dependence of the differential cross section and of the neutron polarization on the polarization of the initial deuterons is considered. The measurable quantities are classified according to their transformation properties and related to the spin dependent parts of the interactions. It is shown which information may be obtained with deuterons that are polarized or aligned in a fixed direction. (auth)

18951 A NEW ISOMERIC STATE IN Eu^{152}. Peter Kirkby and T. M. Kavanagh (McGill Univ., Montreal). Nucl. Phys., 49: 300-5(Nov. 1963).

The ^{152}Eu isotope is shown to have an additional isomeric state above the previously known 9.3 h state. The new isomer has a half life of 96 ± 5 min and decays by a 38 ± 2 kev

transition ($\Delta I = 3$) and a 92 ± 2 kev E1 transition in cascade. (auth)

18952 THE (n,p), (n,d) AND (n,α) REACTIONS INDUCED BY FAST NEUTRONS IN CsI(Tl) SCINTILLATION CRYSTALS. J. C. Robertson (Glasgow Univ.). Nucl. Phys., 49: 306-14(Nov. 1963).

Pulse shape discrimination was used to obtain the energy spectrum of the particles emitted in the nuclear reactions induced by fast neutrons in CsI(Tl) scintillation crystals. Structure is found in the spectrum which is attributed to the (n,d) reaction. The total charged particle cross-section averaged for ^{133}Cs and ^{127}I is found to be $\sigma = 26 \pm 3$ mb. (auth)

18953 THE NEW NUCLIDE HOLMIUM-169. K. Miyano (Tokyo Univ.) and T. Kuroyanagi. Nucl. Phys., 49: 315-20 (Nov. 1963).

Holmium-169 was produced from the $^{170}Er(\gamma,p)$ reaction with 21 Mev bremsstrahlung. The radiations from the irradiated sample were measured with beta- and gamma-ray scintillation spectrometers. The half life of this new nucleide was determined to be $T_{1/2} = 4.8 \pm 0.1$ min. Two beta-ray components were identified with end-point energies of 1.95 and 1.20 Mev. The log ft values for these components were 6.1 and 4.7, respectively. Many gamma rays were also found. A decay scheme was proposed. Analyses were made with the aid of the Nilsson model. (auth)

18954 p′-γ-ANGULAR CORRELATION IN $Cr^{52}(p,p'\gamma)$ AND $Fe^{56}(p,p'\gamma)$ AT 5.8 Mev. B. Gobbi, R. E. Pixley, and E. Sheldon (Eidgenossische Technische Hochschule, Zurich). Nucl. Phys., 49: 353-82(Dec. 1963). (In German)

The reaction mechanism operative in the inelastic scattering of 5.8 Mev protons to the first excited state of Cr^{52} (E = 1.433 Mev) and Fe^{56} (E = 0.845 Mev) is investigated through the following measurements: the $(p,p'\gamma)$-angular correlation of the reaction products, the p′ and γ angular distributions and the linear polarization of the gamma-rays emitted perpendicular to the incident direction. The correlations were measured as a function of the γ-emission angle between 0° and 156° for three angles (θ_p = 45°, 90° and 135°) and for both scattering half-planes, viz. $\varphi = 0$ and $\varphi = \pi$. Comparison of experimental results with the predictions of CN and DI reaction theory indicates the mechanism to be predominantly CN with a small admixture of DI and an insignificant amount of interference between these two reaction mechanisms. An attempt has been made to establish the relative CN and DI contributions to the measured absolute cross section. (auth)

18955 DEFORMED-CORE MODEL RESULTS FOR NUCLEAR BETA-MOMENTS. Chung Wook Kim (Indiana Univ., Bloomington). Nucl. Phys., 49: 383-400(Dec. 1963).

It is found that core-deformations, as treated by Nilsson, can account for a major part of the many types of discrepancy between simple shell-model expectations and observed trends in beta-decay rates, among very light as well as heavier nuclei. Not only are the well-known suppressions of normal allowed transitions relative to shell-model expectations treated, but similar suppressions among forbidden transitions are distinguished here for the first time. Significant confirmation for applications of the deformed-core picture even to mirror nuclei comes from a correlation discovered between certain 1-forbidden decay enhancements and super-allowed decay suppressions. (auth)

18956 CALCULATIONS ON THE QUESTION OF AXIAL ASYMMETRY IN NUCLEI. S. Das Gupta and M. A. Preston (McMaster Univ., Hamilton, Ont.). Nucl. Phys., 49: 401-16 (Dec. 1963).

An investigation is carried out to determine whether or not on the basis of theory one expects axial asymmetry in heavy nuclei. The average one-body potential well is taken as an anisotropic harmonic oscillator modified by the usual $\mathbf{l} \cdot \mathbf{s}$ and $\mathbf{l}^2$ forces. The method of matrix diagonalization is used to find the eigenvalues. Residual interaction between nucleons is also treated in the pairing approximation. The calculations show that prolate axial symmetry is favoured in each of the nuclei considered. It is possible to indicate the underlying physical reasons for this result; the incompressibility of nuclear matter is one of these. The eigenvalues for single particle states in the N = 3, 4, 5 and 6 shells are listed for $\beta = 0.3$ and $\gamma = 0(\frac{1}{12}\pi)\frac{1}{3}\pi$. (auth)

18957 ABSOLUTE CROSS SECTION FOR THE $C^{12}(p,pn)C^{11}$ REACTION AT 50 Mev. J. B. Cumming (Brookhaven National Lab., Upton, N. Y.). Nucl. Phys., 49: 417-23(Dec. 1963).

Absolute cross sections for the $C^{12}(p,pn)C^{11}$ reaction at proton energies between 21 and 50.5 Mev were measured at the Brookhaven Linac. Beam intensity was measured with a Faraday cup and the C^{11} induced in polyethylene foils was assayed in a calibrated well-type scintillation counter. Corrections for C^{11} gas loss from the foils were applied. The $C^{12}(p,pn)C^{11}$ cross section at 50.5 Mev is 86.4 ± 2.6 mb. Absolute cross sections for Na^{24} and Na^{22} production from aluminium were also measured at several energies. (auth)

18958 (α,n) REACTIONS IN LIGHT NUCLEI. G. Deconninck, M. De Vroey, J. P. Meulders, and J. Simonet (Université, Louvain, Belg.). Nucl. Phys., 49: 424-32 (Dec. 1963).

The angular distributions of neutrons from the $Be^9(\alpha,n_0)C^{12}$, $Be^9(\alpha,n_1)C^{12}$, and $C^{13}(\alpha,n_0)O^{16}$ reactions have been taken for α particles of 14 to 23 Mev energy. Variations of the structure with energy are shown which indicate the presence of the compound nucleus effect below 18 Mev for the first two reactions. Plane wave Born approximation analysis is in favor of the knock-out process for the reactions on C^{12}. The structure of the distribution on C^{13} indicates the presence of many interference mechanisms. (auth)

18959 A MEASUREMENT OF THE BETA-BRANCHING RATIO OF Lu^{176m}. C. J. Gallagher, Jr., A. Namenson, and P. C. Simms (Columbia Univ., New York). Nucl. Phys., 49: 443-8(Dec. 1963).

The β^- branching ratio of 3.7-h Lu^{176m} to the 0^+ (ground) and 2^+ (88 kev) levels in Hf^{176} was measured by β-γ coincidence techniques using a Gerholm-type β-γ coincidence spectrometer. The intensities of the inner and ground state groups are 37 ± 12% and 63 ± 12%, respectively. Using a previously reported $Q_{\beta^-} = 1314$ kev, the experimental relative reduced transition probability calculated is $0.34^{+0.30}_{-0.08}$. Because the $I^\pi = 1^-$ for this isomer was previously determined experimentally, the branching ratio establishes the K-quantum of the isomer as K = 0, assuming the validity of the K-intensity rules of the strong coupling model. The $I^\pi K = 1\text{-}0$ assignment of the isomer therefore indicates that Lu^{176m} has an anomalous K = 0 rotational band in which the odd spin band is displaced below the even spin band. (auth)

18960 ATOMIC BEAM STUDIES OF SOME RADIOACTIVE ISOTOPES OF REFRACTORY GROUP ELEMENTS. Walter M. Doyle and Richard Marrus (Univ. of California, Berkeley). Nucl. Phys., 49: 449-55(Dec. 1963). (UCRL-10856)

The spins of several neutron-produced isotopes in the refractory region were measured by the atomic-beam method. They are found to be Ta^{183} ($I = \frac{7}{2}$); W^{185} ($I = \frac{3}{2}$); W^{187} ($I = \frac{3}{2}$); Re^{186} ($I = 1$); Re^{188} ($I = 1$); Ir^{192} ($I = 4$); and

Ir^{194} (I = 1). With the exception of Ir^{192}, these values are consistent with plausible state assignments based on the Nilsson model and with the coupling rules for odd nuclei of Gallagher and Moszkowski. A new method is described for the production of atomic beams of materials having high melting points and low vapor pressures. (auth)

18961 EFFECTS OF PROTON-ALPHA INTERACTION IN (α,p) REACTIONS AND THE REACTION MECHANISM IN (1d,2s) SHELL NUCLEI. Makoto Tanifuji (Hosei Univ., Tokyo). Nucl. Phys., 49: 456-74(Dec. 1963).

An improvement of the knock-out theory for (α,p) reactions is attempted using the impulse approximation and thus taking into account the characteristic features of the proton-alpha interaction. The whole theory is formulated for cases both with and without wave-distortion by nuclei. The mechanism of (α,p) reactions in some (1d, 2s) shell nuclei is investigated using the angular distribution as predicted by the latter theory. The results indicate that the reactions take place predominantly through the stripping process over the nuclei, except that some characteristics of the knock-out process appear in the case of the F^{19} target nucleus. A pure knock-out process having been assumed, the polarization of the emitted protons is calculated for the F^{19} target nucleus and found to be large in the forward angular region. Finally, it is pointed out that, in view of the dispersion relation, the polarization measurement is very important for the determination of the reaction mechanism. (auth)

18962 NUCLEAR BREMSSTRAHLUNG. Walter Greiner and Anthony M. Green (Univ. of Maryland, College Park). Nucl. Phys., 49: 481-8(Dec. 1963).

A formalism for the bremsstrahlung accompanying scattering of nucleons is developed in which the nuclear potential is explicitly worked into the radiation matrix elements. The result is an expansion of the matrix element in a power series of v/c and $\hbar\omega/\mu c^2$. In each term of this series the potential between the scattered particles occurs explicitly. As an application of this formalism, the low energy neutron-proton bremsstrahlung for a square well and a square well plus hard-core nuclear potential fitting the same low energy scattering parameters are calculated. The two potentials give the same bremsstrahlung to within a few percent as expected. In fact, a shape-independent expression for the low energy region is given. The cross section is found to be of the order 10 μb, which should be measurable. (auth)

18963 THE MECHANISM OF THE (n,2n) REACTION. A. Ádám, P. Hraskó, Gabriella Pálla, and P. Quittner (Central Research Inst. of Physics, Budapest). Nucl. Phys., 49: 489-95(Dec. 1963).

An experimental investigation was made on the extent of the angular correlations between the neutrons produced in the (n,2n) reaction. The fast neutrons were detected by means of scintillation counters and fast coincidence circuits. From measurements on bismuth and lead, the cross section of the (n,2n) reaction was found to be 20–30% lower than the values obtained by activation or any other method insensitive to the direction of the emerging neutrons. Thus a correlation between the neutrons is suggested. (auth)

18964 DIFFERENTIAL CROSS SECTIONS AND POLARIZATIONS OF 9.4 Mev PROTONS ELASTICALLY SCATTERED BY Ni^{58}, Ni^{60}, AND Co^{59}. G. W. Greenlees, U. Haznedaroglu, A. B. Robbins, P. M. Rolph, and J. Rosenblatt (Univ. of Birmingham, Eng.). Nucl. Phys., 49: 496-502(Dec. 1963).

Angular distributions are presented for the differential cross sections and polarizations of 9.4 Mev protons elastically scattered from Ni^{58}, Ni^{60}, and Co^{59} over the angular range 15°–150°. Using a set of parameters previously determined from an optical model analysis of similar data for Cu, good fits have been obtained in each case with only small variations in the depth of the real part of the central potential. These variations are attributed to a symmetry potential of the form $V_1(N-Z)/A$, with $V_1 = 19 \pm 5$ Mev. The spin orbit potential originally determined for Cu (v = 6 Mev, w = 0) gives the best fits to the polarisation angular distributions. (auth)

18965 THE $C^{14}(d,n)N^{15}$ REACTION. W. L. Imhof, H. A. Grench, and R. G. Johnson (Lockheed Missiles and Space Co., Palo Alto, Calif.). Nucl. Phys., 49: 503-9(Dec. 1963).

The $C^{14}(d,n)N^{15}$ reaction was studied by observing the neutrons with time-of-flight techniques. Peaks are observed in the time-of-flight spectra corresponding to neutron groups which leave N^{15} in the ground state, the unresolved 5.28 and 5.30 Mev states, the 6.33 Mev state, and the unresolved 7.16 and 7.31 Mev state. Using a 0.27 mg/cm^2-thick target enriched in C^{14} to 17%, the excitation function for the ground-state group was measured at 30° for deuteron energies from 0.93 to 3.18 Mev. Broad peaks are observed in the yield curve at 1.3, 2.1, and 2.75 Mev. Angular distributions for the ground-state group were obtained from 0° to 150° at 1.31, 1.62, 2.10, 2.33, 2.75, and 3.08 Mev. Although the distributions are distinctly different at each energy, pronounced peaking in the backward direction is observed at the four lowest energies. With better energy resolution, angular distributions were also measured for each of the above neutron groups at bombarding energies of 2.10 and 2.33 Mev. (auth)

18966 ISOMERIC CROSS-SECTION RATIOS FOR (n,2n) REACTIONS AT 14 Mev. S. K. Mangal and P. S. Gill (Muslim Univ., Aligarh, India). Nucl. Phys., 49: 510-14(Dec. 1963).

Isomeric cross-section ratios at 14 Mev for reactions $Sb^{123}(n,2n)Sb^{122m,g}$, $Pd^{110}(n,2n)Pd^{109m,g}$, $Zr^{90}(n,2n)Zr^{89m,g}$, and $Ge^{76}(n,2n)Ge^{75m,g}$ were measured. Using the statistical model and the spin distribution form due to Bethe and Bloch, theoretically calculated isomeric ratios were compared with experimentally measured values to find the value for the parameter σ which characterizes the dependence of the nuclear density on angular momentum. (auth)

18967 ON THE THEORY OF (p,pd) REACTIONS AT HIGH ENERGIES. I. S. Shapiro and V. M. Kolybasov (Inst. of Theoretical and Experimental Physics, Moscow). Nucl. Phys., 49: 515-21(Dec. 1963).

The momentum spectra of deuterons produced in the (p,pd) reaction are calculated in the pole approximation. The results of the calculation are compared with the experimental data for the proton energy $E_p = 675$ Mev. Theoretical and experimental results are in qualitative agreement. (auth)

18968 ALPHA PARTICLE TRANSFER REACTIONS IN COLLISIONS OF COMPLEX NUCLEI. V. K. Lukyanov and I. Ž. Petkov (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys., 49: 529-36(Dec. 1963).

A model is suggested for explaining the angular and energy distributions of alpha particles observed in collisions of nuclei of the alpha particle type with heavy nuclei. The character of the link of alpha particles in an incident nucleus plays a decisive role in the mechanism of the process. The available experiments on the angular and energy distribution are discussed. (auth)

18969 NEUTRONS FROM THE $B^{10}(d,n)C^{11}$ REACTION. J. C. Overley (Univ. of Wisconsin, Madison). Nucl. Phys., 49: 537-43(Dec. 1963). (TID-19151)

The $^{10}B(d,n)^{11}C$ reaction was used to study states in ^{11}C at excitation energies between 8.4 and 12.0 Mev. Time-of-flight techniques were employed to analyze the neutrons produced at deuteron energies between 3.0 and 10.0 Mev at 500 kev intervals. The state previously reported at 8.66 Mev was found to be a doublet at 8.655 and 8.700 Mev. The only higher excited state appreciably populated through stripping is at 10.69 Mev. Results of fitting angular distributions with Butler stripping curves suggest $l = 0$ formation of the 8.655 and 8.700 Mev-states and $l = 0$ or 2 formation of the 10.69-Mev state. (auth)

18970 BETA-VIBRATIONS IN EVEN NUCLEI. D. R. Bès (Facultad de Ciencias Exactas y Naturales, Buenos Aires). Nucl. Phys., 49: 544-65(Dec. 1963).

The properties of β vibrations in even nuclei are calculated within the quasi-boson approximation. A modification of the usual method is necessary in order to eliminate effects due to the existence of spurious states. The agreement of the theoretical results with the experimental values is satisfactory. (auth)

18971 NUCLEAR ISOMERISM IN Hg^{197}, Sc^{44}, AND Y^{87} PRODUCED IN He^3 BOMBARDMENTS. A. J. Cox (Univ. of Birmingham, Eng.). Nucl. Phys., 49: 577-85(Dec. 1963).

Helium-3 particles of energy up to 28 Mev were used to produce the three nuclides ^{197}Hg, ^{44}Sc, and ^{87}Y in their ground and isomeric states. The dependence of the formation cross-sections for the two levels on bombarding energy was studied in each case. The results are compared with theoretical curves predicted from the statistical model and the evaporation theory as used by Huizenga and Vandenbosch. In each case agreement between theory and experiment is found to be reasonable if the parameter σ describing the variation of level density with spin has the value 4 ± 1. (auth)

18972 CHARGE-INDEPENDENT PAIRING CORRELATIONS. B. H. Flowers and M. Vujičić (Univ. of Manchester, Eng.). Nucl. Phys., 49: 586-604(Dec. 1963).

It is shown that the generalization of the BCS method of treating correlations due to pairing forces when these forces are charge-independent leads inevitably to there being 4-body correlations whose symmetry properties are similar to those of an α-particle model. Rough estimates of the magnitude of the correlations indicate that it is probably strong enough to account for the energy gap found in light nuclei. (auth)

18973 GAMMA INTENSITIES IN THE DECAY OF Ir^{192}. Boerje Lindstroem and Ingvar Marklund (Univ. of Uppsala). Nucl. Phys., 49: 609-23(Dec. 1963).

The relative gamma intensities in the decay of ^{192}Ir were measured in a bent-crystal spectrometer and a double focusing beta spectrometer in order to compare the accuracy of the crystal diffraction and photoconversion methods. Fifteen gamma transitions in the energy region of 136 to 613 kev were studied; the intensities of ten of these were measured in both spectrometers. The intensity determinations from the two methods give equal results within the experimental errors of about 10%. Accurate gamma energy determinations were also performed. The decay scheme of ^{192}Ir is discussed. (auth)

18974 PROPERTIES OF THE 57 AND 351 kev EXCITED STATES IN $_{59}Pr^{143}$. R. L. Graham, J. M. Hollander, and P. Kleinheinz (Univ. of California, Berkeley). Nucl. Phys., 49: 641-50(Dec. 1963). (UCRL-10792)

Some features of the decay scheme of ^{143}Ce were studied with a 50-cm radius iron-free beta-spectrometer equipped with a nanosecond time sorter. From the measured L-subshell conversion ratios the (57.37 ± 0.05)-kev transition is found to be predominantly M1, with less than 0.3% E2 admixture. The half life of the 57-kev state is measured as 4.17 ± 0.09 nsec. Similarly, the (293.3 ± 0.1)-kev M1-E2 transition, de-exciting the 350.7-kev level, is found to have a 34 ± 16% E2 admixture and half life ≥ 0.3 nsec. The K-line of the (350.7 ± 0.1)-kev crossover transition was also observed. Analysis of these data, in combination with angular correlation results of others, supports a $5/2^+$ assignment for the 57.37-kev level, and suggests a $3/2^+$ assignment for the 350.7-kev state. The magnetic moment of the 57-kev state is discussed in terms of the presently available data. (auth)

18975 RELATIONSHIPS BETWEEN BETA-MOMENTS AND GAMMA-MOMENTS. Chung Wook Kim (Indiana Univ., Bloomington). Nucl. Phys., 49: 651-60(Dec. 1963).

Theoretical relations between beta moments (beta-decay nuclear matrix elements) and corresponding gamma moments are derived. Direct relations for cases in which the parent states of beta and gamma decays are members of the same isomultiplets are generalized, and corrections for the effects which tend to destroy charge-independence are taken into account. The applications of the results to the available cases show that the contribution of the nuclear potential effect is negligible. The theoretical relations are used, instead of using the experimental values as done by Gell-Mann, for evaluating expectations from the conserved vector current theory. The results are in better agreement with the experiments than the previous predictions. (auth)

18976 NON-RESONANT RADIATION FROM THE N^{14} (p,γ) REACTION. [PART] II. D. F. Hebbard and G. M. Bailey (Australian National Univ., Canberra). Nucl. Phys., 49: 666-85(Dec. 1963).

Measurements were made of the cross section factors for cascades in $^{14}N(p,\gamma)$ through the 6.79-, 6.16-, and 5.18-Mev states of ^{15}O and for the ground-state transition over the proton energy range from 210 to 1070 kev. Individual extrapolations to stellar energy are made. For the sum of the cross section factors, the zero-energy intercept is $S(0) = 2.75 \pm 0.50$ kev • b with zero slope. Over most of the energy range, the cascades through the 6.79- and 6.16-Mev levels dominate. At stellar energies, these account for 50 and 40%, respectively, of the reaction rate. The extrapolation is in satisfactory agreement with the results of others at low energies. (auth)

18977 SHELL EFFECTS IN THE (n,α) CROSS-SECTIONS AT 14 Mev. Aparesh Chatterjee (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Phys., 49: 686-93(Dec. 1963).

A further compilation of (n,α) cross-sections at ≈ 14 Mev was made. The shell dependence was studied in some detail. It is found that minima in the cross sections are present in all the major proton shell closure positions of the residual nuclear charge Z_R. There are sub-minima in all the known proton sub-shell closure regions at $Z_R = 2$, 14, ≈ 32, ≈ 38, 58, and ≈ 72. No minima due to neutron shells or sub-shells are observed except in cases of the doubly magic nuclei. (auth)

18978 THEORY OF NUCLEAR REACTIONS. IV. COULOMB INTERACTIONS IN THE CHANNELS AND PENETRATION FACTORS. J. Humblet (Université, Liege). Nucl. Phys., 50: 1-16(Jan. 1964).

The expansion of the collision matrix as the sum of a background term and a series of resonant terms given in part I is extended to include the Coulomb interactions in the channels without cut off at large distances. The penetration factors introduced are independent of the channel radii. (auth)

18979 THE STRUCTURE OF THREE AND FOUR NUCLEON PROJECTILES FROM STRIPPING REACTIONS. M. El Nadi and F. Riad (Atomic Energy Establishment, Cairo). Nucl. Phys., 50: 33-40(Jan. 1964).

The structure of three and four nucleon projectiles is studied by using the experimental data on the stripping reactions. The ratio of cross sections for the (α,t) and (d,n) or (α,^{3}He) and (d,p) reactions, respectively, for transitions between the same energy levels enables one to determine the probability for the existence of the α particle as a triton or ^{3}He particle plus a proton or neutron, respectively. This is found to be about 14%. A similar analysis is carried out for triton reactions. (auth)

18980 GAMMA RAYS FROM Au^{197}. Paul B. Griesacker and R. R. Roy (Pennsylvania State Univ., University Park). Nucl. Phys., 50: 41-8(Jan. 1964).

New gamma rays are found in ^{197}Au from negaton decay of ^{197m}Pt prepared by fast neutron capture in ^{196}Pt. The assignment of these new gamma transitions to ^{197}Au is established through gamma-gamma and beta-gamma coincidence measurements along with half life considerations. A tentative decay scheme of ^{197}Au is proposed. (auth)

18981 THE NEUTRON TRANSFER REACTION $Ca^{40}(p,d)Ca^{39}$ AT 30 Mev PROTON ENERGY. P. E. Cavanagh, C. F. Coleman, G. A. Gard, B. W. Ridley, and J. F. Turner (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Phys., 50: 49-60(Jan. 1964).

Deuteron groups from the reaction ^{40}Ca(p,d)^{39}Ca were observed at an incident proton energy of 30 Mev. The angular distributions of the ground state group and of a second group going to states in ^{39}Ca with a mean excitation of 2.65 ± 0.15 Mev were fitted with theoretical curves for l_n = 2 and l_n = 0, respectively, using a D.W.B.A. computer program. The experimental results correspond to neutron occupation numbers of 8.9 and 4.3 for the $d_{\frac{3}{2}}$ and $s_{\frac{1}{2}}$ configurations in ^{40}Ca, to be compared with the theoretically expected values of 4 and 2. (auth)

18982 ANALYSIS OF THE REACTION $B^{11}(d,n)C^{12}_{4.43}$ Mev. M. A. Nagarajan (Case Inst. of Tech., Cleveland) and A. P. Arya. Nucl. Phys., 50: 61-5(Jan. 1964).

Distorted wave analysis of the reaction ^{11}B(d,n)^{12}*C leading to the 4.43 Mev level of ^{12}C was done for a deuteron energy of 5.35 Mev. The stripping amplitudes so obtained were used to obtain the neutron-gamma correlation following the decay of the 4.43 Mev state of ^{12}C. A comparison is made with the experimental results. (auth)

18983 INELASTIC DEUTERON SCATTERING. A COMPILATION AND DISCUSSION OF AVAILABLE DATA. E. W. Hamburger (Universidade de Sao Paulo, Brazil). Nucl. Phys., 50: 66-105(Jan. 1964).

The available data on inelastic deuteron scattering at incident energies above 7 Mev are compiled. The general features of the data are extracted and discussed. The theories proposed for (d,d') are briefly described. A bibliography of elastic deuteron scattering experiments is given in an appendix. (auth)

18984 INVESTIGATION OF ELASTIC AND INELASTIC SCATTERING OF PROTONS FROM THE NUCLEUS Ne^{22}. M. A. Abuzeid, Y. P. Antoufiev, A. T. Baranik, M. I. El-Zaiki, T. M. Nower, and P. V. Sorokin (Egyptian Atomic Energy Establishment, Cairo). Nucl. Phys., 50: 106-12 (Jan. 1964).

Excitation functions for the reactions ^{22}Ne(p,p)^{22}Ne and ^{22}Ne(p,p'γ)^{22}Ne, Q = −1.28 Mev in the energy range of protons 1.5-2.5 Mev were measured. For strong resonances the angular distributions of inelastically scattered protons and the corresponding γ rays were measured. Spins, parities, resonance strengths, and reduced widths were determined for six levels of the compound nucleus ^{23}Na. (auth)

18985 DECAY OF 78.4 h Zr^{89} AND 4.18 min Zr^{89m}. D. M. Van Patter and S. M. Shafroth (Franklin Inst., Swarthmore, Penna.). Nucl. Phys., 50: 113-35(Jan. 1964).

The half lives of ^{89}Zr and ^{89m}Zr radioactive sources produced by the ^{89}Y(p,n) reaction were measured as 78.43 ± 0.08 h and 4.18 ± 0.01 min, respectively. Studies of ^{89}Zr γ spectra revealed a new 1.62 Mev component (0.12 ± 0.01%), arising from a new branch to the 2.53 Mev level in ^{89}Y(log ft = 7.3), in addition to the known branch to the 2.61 Mev level (log ft = 6.1). The total feeding by positons in the ^{89m}Zr decay was measured as 1.47 ± 0.09% of which 0.2 ± 0.1% is attributed to the anomalously hindered transition to the ground state of ^{89}Y (log ft = 7.0 ± 0.2). A discussion of these transition probabilities in terms of mixed configurations and isobaric spin analog states is included. The intensity of a previously unobserved sum peak provided a direct determination of the electron capture to positon feeding of the 1.51 Mev level, ϵ/β^+ = 3.76 ± 0.19, which exceeds the theoretical estimate of 3.34 ± 0.16. A similar measurement for the primary ^{89}Zr branch yielded ϵ/β^+ = 3.43 ± 0.10 compared to the theoretical estimate of 3.21 ± 0.13. (auth)

18986 ANALYTIC TREATMENT OF COULOMB DISTORTIONS IN L = 0 STRIPPING REACTIONS. Fernando B. Morinigo (California Inst. of Tech., Pasadena). Nucl. Phys., 50: 136-44(Jan. 1964).

Analytic expressions for first-order stripping amplitudes, using Coulomb waves for the description of relative motions in both entrance and exit channels are obtained. The initial bound state (i.e., the projectile) is assumed to be asymptotic, having a wave function of the form $e^{-\alpha r}/r$. The final bound state (i.e., the resultant nucleus) may be taken to have a wave function of the Hulthén shape $(e^{-\beta r} - e^{-\beta' r})/r$. The cross sections predicted by these distorted wave expressions are compared to the predictions of analogous plane wave amplitudes. It is found that the angular distributions are qualitatively indistinguishable for a large range of parameters, including even severe distortions. The magnitudes of the predicted cross sections, however, are much smaller than the magnitudes predicted by plane wave expressions and are much closer to measurements. A fit to data for the ^{6}Li(^{3}He,p)^8*Be (16.63 Mev) reaction is given, involving a reduced width as the only parameter. At 2.6 Mev bombarding energy, the plane wave theory gives an answer which differs by factors such as 24 at forward angles and 36 at backward angles. (auth)

18987 TOTAL REACTION CROSS SECTIONS FOR 29 Mev PROTONS. Motoji Q. Makino (Univ. of Southern California, [Los Angeles]), Charles N. Waddell, and Robert M. Eisberg. Nucl. Phys., 50: 145-56(Jan. 1964).

The USC proton linear accelerator is used in a program of measuring the energy dependence of proton total reaction cross sections. As a first step in this program measurements were made using the full beam energy. The anticoincidence beam attenuation technique was used. The following cross sections were obtained for 29 Mev protons: C, 418 ± 18 mb; Al, 775 ± 37 mb; Ni, 1023 ± 40 mb; Ag, 1471 ± 71 mb; and Au, 2209 ± 118 mb. These cross sections are compared to other measurements and optical model analyses. (auth)

18988 S AND P WAVE STRENGTH FUNCTIONS AND THE SURFACE ABSORPTION OPTICAL MODEL. A. P. Jain (Brookhaven National Lab., Upton, N. Y.). Nucl. Phys., 50: 157-70(Jan. 1964). (BNL-7195)

The effect of the surface absorption in the spherical and deformed optical model is analyzed with the view of obtaining improved agreement of S-wave strength function data with the model. It is found that the inclusion of surface absorption is not enough to explain the S-wave strength function data near the 3S and 4S size resonances and in the valley in between ($A \approx 100$) simultaneously. The diffuseness of the Eckart potential is found to be (0.5 ± 0.1) fm for all the nuclei from $A \approx 45$ to $A \approx 240$, even when the surface absorption model is considered. The validity of $A^{1/3}$ law for the nuclear radius is discussed. From a fit to the experimental radii data, the parameter r_0 in the radius formula $R = r_0 A^{1/3}$ is deduced. The area sum rule is found to depend, although rather weakly, on the nature of the potential used (surface or volume absorption). The results for the black nucleus model, $W \approx V$ are compared with the calculations of the area under the size resonance. Other information that could be obtained from the improved data is discussed. (auth)

18989 THE HALF-LIFE OF N^{16}. J. K. Bienlein and Elsbeth Kalsch (Universität, Erlangen, Ger.). Nucl. Phys., 50: 202-8(Jan. 1964).

The radioactive nuclide ^{16}N was produced by the reaction $^{16}O(n,p)^{16}N$ with 14 Mev neutrons. The γ radiation following the β-decay $^{16}N \rightarrow {}^{16}O$ was measured with a scintillation counter. The radioactive decay was observed over 9 half lives. Special attention was given to the measurement of the background and its possible influence to the value of the ^{16}N half life. The measurement yielded $T_{1/2}(^{16}N \rightarrow {}^{16}O) = 7.14 \pm 0.02$ sec. (auth)

18990 SPINS OF LEVELS IN N^{15}, Fe^{57}, Cu^{64}, Zr^{92}, AND Hg^{200} BY NEUTRON CAPTURE γ-RAY DIRECTIONAL CORRELATIONS. G. A. Bartholomew and J. F. Vervier (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Phys., 50: 209-33(Jan. 1964).

Neutron capture γ directional correlations, with the assumption of negligible M2 admixture in high energy E1 transitions, are used to deduce spins of levels in ^{15}N, ^{57}Fe, ^{64}Cu, ^{92}Zr, and ^{200}Hg. For several of the correlations studied, multipolarities of primary γ rays, and hence parities of certain levels, are inferred from the systematics of neutron capture γ radiation strengths and other information. On this basis, the following assignments are made: ^{15}N: 6.32 Mev level, $3/2$ or $5/2$; ^{57}Fe: 0.365 Mev level, $3/2$; ^{64}Cu: 0.277 and 0.607 Mev levels, 1 or 2^+; ^{92}Zr: 2.33 Mev level, 3^-, negative energy resonance dominating thermal capture, 2; ^{200}Hg: 1.59 Mev and 2.10 Mev levels, 1^+, resonance at -2 ev, 0. In ^{200}Hg, as a consequence of the spin 0 capturing state assignment and E1 multipolarity assignments for primary γ rays, levels at 2.39, 2.64, 2.97, 3.09, 3.21 and 3.38 Mev are tentatively concluded to be 1^+. Information concerning γ multipole mixtures is also obtained in ^{15}N and ^{57}Fe. (auth)

18991 OCTUPOLE VIBRATIONS OF DEFORMED EVEN-MASS NUCLEI. D. P. Leper (Lebedev Inst. of Physics, Moscow). Nucl. Phys., 50: 234-40(Jan. 1964).

Octupole vibrations of deformed even-mass nuclei are considered in terms of the collective model. The second quantization method is applied. It is shown that g-vibrations are accurately separated from γ vibrations for any frequency. The reduced probability for M2 transition from the g-band is calculated. (auth)

18992 EXCITATION FUNCTIONS AND ANGULAR DISTRIBUTIONS FOR THE REACTION $C^{12}(He^3,n)O^{14}$. G. U. Din, H. M. Kuan, and T. W. Bonner (Rice Univ., Houston, Tex.). Nucl. Phys., 50: 267-72(Jan. 1964). (TID-19244)

Excitation functions at 0° and 90° and the total yield from the reaction $^{12}C(^3He,n_0)^{14}O$ were measured for ^3He bombarding energies from 1.8 to 5.5 Mev. Angular distributions were measured at 1.87, 2.33, 2.66, 2.87, 3.11, 3.93, 4.49, 4.75, and 5.19 Mev. The excitation curves and the total yield show considerable resonance structure. The angular distributions vary from isotropic to backward peaking at low energy and above 4 Mev bombarding energy are peaked in the forward direction. (auth)

18993 PROTONS FROM THE $Cu^{63}(p,p')$ REACTION. N. Cindro (Universitet, Copenhagen), D. B. Fossan, and D. Zastavniković. Nucl. Phys., 50: 281-5(Jan. 1964).

The energy spectra of inelastic protons from a thin ^{63}Cu target bombarded with protons of energies between 5–11 Mev were measured at 105°. The independence of the shape of the reduced energy spectra on bombarding energy implied the validity of statistical theory. Assuming compound-nucleus formation, the deduced level densities were best fit with a constant-temperature model ($T \approx 1.5$ Mev). (auth)

18994 PAIR PRODUCTION BY 6-Mev LINEARLY POLARIZED γ-RAYS. I. Khubeis, H. Schopper, and C. Weddigen (Technische Hochschule and Kernforschungszentrums, Karlsruhe, Ger.). Nucl. Phys., 50: 286-94 (Jan. 1964).

The production of electron pairs in nuclear emulsions by linearly polarized photons was investigated. It was found that more pair particles are emitted perpendicular to the photon polarization plane if the pair and the photon are coplanar. They are emitted preferentially in the polarization plane if they are not coplanar. The distribution of the angle θ between one pair particle and the incident photon and of the opening angle ω of the pairs was also determined. The results are in good agreement with recent calculations. (auth)

18995 INTERNAL CONVERSION STUDIES OF THE $2^+ \rightarrow 0^+$ TRANSITIONS IN SOME DEFORMED EVEN NUCLEI. B. V. Thosar, M. C. Joshi, R. P. Sharma, and K. G. Prasad (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys., 50: 305-16(Jan. 1964).

The K conversion coefficients of $2^+ \rightarrow 0^+$ transitions in some deformed even nuclei were determined with the help of β–γ, x–γ, and γ–γ coincidence measurements. All possible uncertainties in these measurements have been minimized and properly evaluated. The α_K values for $2^+ \rightarrow 0^+$ transitions in ^{166}Er, ^{170}Yb, ^{178}Hf, ^{186}W, ^{188}Os, ^{188}Os, and ^{160}Dy are found to be 1.67, 1.31, 1.10, 0.55, 0.42, 0.34, and 1.52, respectively. These values are in agreement with the theoretical ones within an experimental error of about 6%. Large deviations of the order of 15 to 20% as reported by earlier workers are not observed. (auth)

18996 ANGULAR CORRELATION OF γ-RAYS IN INELASTIC DIFFRACTION SCATTERING. E. V. Inopin and S. Shehata (Atomic Energy Establishment, Cairo). Nucl. Phys., 50: 317-26(Jan. 1964).

The gamma-ray correlation function following inelastic excitation of the first rotational level of an even-mass nucleus by a spinless projectile was analyzed taking into consideration non-adiabaticity. In the linear approximation over the non-adiabaticity parameter the gamma distribution in the scattering plane reduces to the form $\sin^2[2(\Theta_\gamma - \Theta_0)]$, where the parameter Θ_0 is not equal to the adiabatic recoil angle $\Theta_{R(ad)}$ in contrast to the result calculated in the adiabatic approximation by Blair and Wilets. The difference $\Delta = \Theta_0 - \Theta_{R(ad)}$ has a maxima for projectile scattering angles corresponding approximately to the minima of the angular distribution; Δ is negative in the left neighborhood of the minimum and positive on the right of the minimum. (auth)

18997 THE MEASUREMENT OF THE TOTAL PROTON REACTION CROSS-SECTION OF CARBON IN THE ENERGY REGION UP TO 50 Mev. R. A. Giles and E. J. Burge (King's Coll., London). Nucl. Phys., 50: 327-36 (Jan. 1964).

Measurements are reported of the carbon total proton reaction cross section at 22 (420 ± 42 mb) and 42 Mev (405 ± 38 mb). A method is developed in which pulse-height spectra from plastic scintillator are carefully analyzed to give the total number of low pulse-height events obtained with a mono-energetic incident beam. Theoretical analyses are made of the shape of the main peak to be expected for incident energies of 10, 30, and 50 Mev. (auth)

18998 FINITE RANGE AND EXCHANGE EFFECTS IN THE REACTION $^{28}Si(n,p)^{28}Al$. A. Agodi and G. Schiffrer (Università, Catania, Italy). Nucl. Phys., 50: 337-45(Jan. 1964).

The angular distribution of protons from the reaction $^{28}Si(n,p)^{28}Al$ induced by 14.1 Mev neutrons and leaving the nucleus ^{28}Al in the ground or in the first excited state has been calculated in the distorted wave Born approximation assuming a finite range effective n-p interaction. Some of the calculated curves are reported; they display the relevance of a Majorana exchange term in the effective interaction and of the optical model distortions in the initial and in the final state for obtaining a reasonable agreement with the experimental data. It is found that, in order to get from the theory the measured absolute value of the cross section, with the optical model distortions fitting the elastic scattering data, the effective interaction must be normalized in strength to the t-matrix describing nucleon-nucleon scattering in nuclear matter, with binding effects included. (auth)

18999 DECAY OF ^{157}Tb. Ichiro Fujiwara (Kyoto Univ.), Shiro Iwata, Tomota Nishi, Shiro Goda, Masayuki Tabushi, and Tsunenobu Shigematsu. Nucl. Phys., 50: 346-52(Jan. 1964).

A sample of Gd_2O_3 enriched to 97.01% in the mass number 156 was bombarded with 38.5-Mev alpha particles. The activity of ^{157}Dy produced by the $(\alpha,3n)$ reaction was isolated chemically from the target material. The number of nuclei of ^{157}Dy was determined from the counting rate on the 330 kev photopeak. After the ^{157}Dy radioactivity ($T_{1/2}$ = 8.2h) had died out, terbium was separated from dysprosium. The scintillation spectrum of the terbium fraction showed only one photopeak at the energy of 43 kev x rays of gadolinium when the source was situated inside a well-type crystal. The number of ^{157}Tb nuclei was determined from the counting rate of the K x rays in the well-type crystal and by the measurement of the K and L orbital electron capture ratio with a thin NaI(Tl) crystal. From the number of nuclei of the parent and the daughter, the half life of ^{157}Tb was estimated to be 150 ± 30 y. A decay scheme of ^{157}Tb is proposed. (auth)

19000 POTASSIUM-47. T. Kuroyanagi (Japan Atomic Energy Research Inst., Tokyo), T. Tamura, K. Tanaka, and H. Morinaga. Nucl. Phys., 50: 417-23(Jan. 1964).

Potassium-47 was identified after bombardment of natural calcium and enriched ^{48}Ca targets with bremsstrahlung. From purely radiochemical considerations a new activity of 17.5 ± 0.3 sec half life is assigned to ^{47}K. The main part of the decay is a 4.0 Mev negaton feeding a 2.0 Mev state in ^{47}Ca. A weaker beta branch which decays via a 2.6 Mev state and a very weak high energy beta component feeding directly to the ground state of ^{47}Ca were also detected. The decay characteristics are well understood by taking single-hole configurations for ground states of both ^{47}K and ^{47}Ca and the 2.0 Mev states of the latter. However, not much can be said about the 2.6 Mev state. (auth)

19001 THE BINDING OF ΛΛ-HYPERNUCLEI. R. H. Dalitz and G. Rajasekaran (Univ. of Chicago). Nucl. Phys., 50: 450-64(Jan. 1964). (EFINS-63-54).

The binding energies of $^{10}_{\Lambda\Lambda}Be$ and $^{6}_{\Lambda\Lambda}He$, considered as three-particle systems (Λ-Λ-nucleus), are calculated as functions of the Λ-Λ potential strength by a variational procedure using a trial function $F(r_1)F(r_2)G(r_{12})$, where F, G are of the form $(\exp(-\alpha r^2) + z \exp(-\beta r^2))$. This wave function allows the description of strong Λ-Λ spatial correlations. With $B_{\Lambda\Lambda} = 17.5 \pm 0.6$ Mev for $^{10}_{\Lambda\Lambda}Be$, the volume integral for the Λ-Λ potential is 322 ± 26 Mev · fm^3, leading to the scattering length $a_{\Lambda\Lambda} = 1.76 \pm 0.33$ fm; essentially the same result is obtained for the Λ-Λ potential if the Λ-Λ hypernucleus observed is interpreted as $^{11}_{\Lambda\Lambda}Be$. The non-mesic and mesic decay rates for $^{9}_{\Lambda}Be$ and $^{10}_{\Lambda\Lambda}Be$ are estimated; the (non-mesic)/(π^- mesic) ratio for $^{10}_{\Lambda\Lambda}Be$ is found to be about 25% higher than that estimated for $^{9}_{\Lambda}Be$. For $^{6}_{\Lambda\Lambda}He$, $B_{\Lambda\Lambda}$ is computed and discussed as function of $v_{\Lambda\Lambda}$ for both attractive and repulsive Λ-Λ interactions. The calculation is discussed in some detail. (auth)

19002 THE EFFECT OF THE NON-STATIC FORCES IN NUCLEAR MATTER. M. Razavy (Univ. of Alberta, Edmonton, Can.). Nucl. Phys., 50: 465-78(Jan. 1964).

The relation between two different forms of the non-static potentials arising from the relativistic corrections and the recoil effects in the nucleon-nucleon interaction is investigated. It is shown that by a suitable choice of the static parts, these two different forms are equivalent and will produce the same phase shift for two-nucleon scattering. However, in the many-body problem, in general they give different results for the amplitude of the reaction matrix. Modified Born approximation has been used to evaluate the change in the single particle potential energy in nuclear matter caused by the addition of the quadratic spin-orbit potentials of Breit and Hamada-Johnson. This change, which is about 6 Mev for the Breit potential at the density corresponding to the Fermi momentum $k_F = 1.5$ fm^{-1}, is important both for the determination of the binding energy and the equilibrium density of nuclear matter. (auth)

19003 OPTICAL MODEL AND DISTORTED WAVE ANALYSIS OF (d,d), (d,p), AND (d,d') REACTIONS ON O^{16}, Ni^{58}, Pb^{207}, AND Pb^{208} AT 27.5 Mev. J. Testoni (Comision Nacional de Energia Atomica, Buenos Aires), S. Mayo, and P. E. Hodgson. Nucl. Phys., 50: 479-88(Jan. 1964).

Angular distributions for the elastic scattering of 27.5 Mev deuterons by isotopically separated ^{207}Pb and ^{208}Pb targets and distributions of the proton groups resulting from stripping reactions were measured. The elastic scattering data, together with similar data for ^{16}O and ^{58}Ni, were analyzed using the diffuse-surface nuclear optical model with a volume absorption potential. The data were reasonably well fitted with model parameters obtained by an automatic least-squares procedure. Using optical-model parameters obtained from the elastic scattering analyses, the inelastic scattering and (d,p) stripping angular distributions were fitted by strong coupling and distorted wave Born approximation calculations. (auth)

19004 DETERMINATION OF THE HALF LIFE OF THE NATURALLY OCCURRING RADIOACTIVE NUCLIDES Sm^{147} AND Lu^{176} WITH LIQUID SCINTILLATORS. Dieter Donhoffer (Inst. for Radium Research and Nuclear Physics, Austrian Academy of Sciences, Vienna). Nucl. Phys., 50: 489-96(Jan. 1964). (In German)

In the lutetium sample a thorium contamination was found by analysis of the measured gamma-ray spectrum. After

purification by ion-exchange no gamma-activity could be found besides the one due to ^{176}Lu. The half life of ^{147}Sm is found to be $(1.04 \pm 0.03) \times 10^{11}$ yr; the half life of ^{176}Lu is reported as $(2.18 \pm 0.06) \times 10^{10}$ yr. (auth)

19005 EFFECT OF PAIRING CORRELATIONS ON ALLOWED BETA TRANSITIONS OF G-T TYPE. Mitsuo Sakai and Shiro Yoshida (Tokyo Univ.). Nucl. Phys., 50: 497-515(Jan. 1964).

Allowed beta transitions of the G-T type, $p_{\frac{1}{2}} \rightarrow p_{\frac{1}{2}}$ in the Ga–Sr region, $g_{\frac{9}{2}} \rightarrow g_{\frac{9}{2}}$ in the Rh–In region and $d_{\frac{5}{2}} \rightarrow d_{\frac{5}{2}}$ in the Sb–Nd region are investigated in terms of pairing theory. Experimental ft values can be explained as the effect of pairing correlation. Fractional occupation parameters U and V are derived from the experimental data. The values thus obtained are consistent with those from the cross sections of (d,p) and (d,t) reactions. These U and V values are compared with those calculated using the newly adopted nuclear parameters of pairing theory. The B value defined as $ft = B\xi/|\langle j_f||\sigma||j_i\rangle|^2$ is deduced. The mean log B value is 4.46, 4.86, and 5.00 for the first, second, and third region, respectively. The B value is 9 to 30 times larger than that in transitions between mirror nuclei. The results may imply that the allowed beta transitions are more hindered in a nuclear region with heavier mass number. (auth)

19006 THE $B^{10}(p,\alpha)Be^7$ REACTION BETWEEN 2 AND 11 Mev. J. G. Jenkin, L. G. Earwaker, and E. W. Titterton (Australian National Univ., Canberra). Nucl. Phys., 50: 516-24(Jan. 1964).

Excitation functions, cross sections, and angular distributions for α particles from the $^{10}B(p,\alpha)^7Be$ reaction were measured for laboratory proton energies from 1.8 to 10.8 Mev. These data were analyzed in terms of the presence and properties of levels of the compound nucleus ^{11}C. The state at 12.65 Mev (E_p = 4.36 Mev) was tentatively assigned $\frac{7}{2}^+$, and the partial widths for this level Γ_p, $\Gamma\alpha_0$ and $\Gamma\alpha_1$ were determined. (auth)

19007 THE ELASTIC SCATTERING OF ^{3}He PARTICLES OF ENERGY 24-29 Mev BY C, N, A AND I. H. M. Sen Gupta (St. Bartholomew's Hospital Medical Coll., London), J. Rotblat, E. A. King, and J. B. A. England. Nucl. Phys., 50: 549-60(Jan. 1964).

The elastic angular distributions of ^{3}He particles scattered from carbon at 26.8, 25.3, and 24.5 Mev, nitrogen at 25.7 Mev, argon at 26.4 Mev, and iodine at 29.1, 28.2, 26.6, 24.6, and 24.1 Mev were measured using a nuclear plate camera. Results show a pronounced diffraction oscillation in light nuclei, becoming progressively weaker in argon, leaving an approximately exponential fall-off in cross section in iodine. In iodine a rise in cross-section above the Rutherford value immediately before fall-off was observed. An optical model with a diffuse surface was used to analyze these data and the best fit parameters obtained. (auth)

19008 PROPERTIES OF THE $^{12}C(\gamma,3\alpha)$ REACTION BELOW 21.5 Mev. M. Elaine Toms (Naval Research Lab., Washington, D. C.). Nucl. Phys., 50: 561-84(Jan. 1964).

The cross section for the photodisintegration of ^{12}C yielding alpha particles has been measured by studying 768 events in nuclear emulsions exposed to 21.5 Mev bremsstrahlung filtered by 86.2 cm of graphite or by 41.9 cm of aluminium. The value of the cross section integrated up to 20.5 Mev is 0.82 ± 0.03 Mev · mb. The shape of the cross section indicates resonances and suggests six energy regions for study. Of the total events, 103 could be attributed to breakup via the ground state of ^{8}Be and 557 to breakup via the first excited state of ^{8}Be. The cross section for the remaining 108 events, not definitely attributable to breakup via either ^{8}Be state, does not resemble the cross section for either the ground state or the first excited state events. The angular distribution of the first alpha particle with respect to the photon for the 77 ground state events produced by ^{12}C excitation of less than 14.3 Mev indicates that both E2 and E1 interactions are taking place. The modes of interaction which gave the predicted alpha energy distributions in the best agreement with the data for the first excited state events by ^{12}C excitation regions are 0.25 M1 and 0.75 E1 for 12.2-14.2 Mev, 0.8 E1 and 0.2 E2 for 14.3-16.3 Mev, 0.4 E2 and 0.6 M1 for 16.4-17.9 Mev, 0.88 M1 and 0.12 E2 for 18.0-19.5 Mev and all E1 for 19.6-21.8 Mev. (auth)

19009 NUCLEAR POLARISATION FOLLOWING PHOTOPRODUCTION OF PIONS FROM NUCLEI. [PART] II. G. Ramachandran (Inst. of Mathematical Sciences, Madras) and V. Devanathan. Nucl. Phys., 50: 593-8(Jan. 1964).

It is shown that the polarization of the outgoing nucleon in processes like $\gamma + {}^{29}Si_{14} \rightarrow {}^{28}Si_{14} + p + \pi^-$ or $\gamma + {}^{13}C_6 \rightarrow {}^{12}C_6 + p + \pi^-$ is sensitive to the quenching of the nucleon magnetic moment in the initial bound state. The nucleon polarization in such processes is not only independent of the initial wave function of the nucleon but also independent of the presence of other nucleons in j-j or L-S or intermediate coupling, except for their effect in modifying the extent of quenching and possibly introducing multiple scattering corrections. (auth)

19010 ATTENUATION OF THE GAMMA-GAMMA DIRECTIONAL CORRELATION IN ^{46}Ti. Takeo Hayashi, Atsushi Aoki, and Tsuyoshi Tomiyama (Kyoto Prefectural Univ.). Nucl. Phys., 50: 599-603(Jan. 1964).

The directional correlation between the 1.119 Mev gamma ray and the 0.887 Mev gamma ray in ^{46}Ti was studied. The experimental data agree well with a theoretical curve for the 4(Q)2(Q)0 sequence. The attenuation of the angular correlation coefficient in the measurement is not so marked as to explain that experienced by Boehm and Rogers in their measurement of the beta-gamma circular polarization correlation on the same isotope. (auth)

19011 ELASTIC SCATTERING OF 2-11 Mev PROTONS BY He^4. A. C. L. Barnard, C. M. Jones, and J. L. Weil (Rice Univ., Houston, Tex.). Nucl. Phys., 50: 604-20(Jan. 1964). (TID-19048)

Cross sections for the elastic scattering of protons by ^{4}He were measured for proton energies in the range $2 \leq E_p \leq 11$ Mev (lab system). Excitation functions, measured at center-of-mass angles 30.9°, 90.0°, 109.7° and 164.4° from E_p = 4 to 11 Mev in 100-200 kev steps, showed no fine structure. Angular distributions were measured at 1 Mev intervals from E_p = 2 to 10 Mev with 1% counting statistics, and scattering phase shifts were obtained from these data. An angular distribution was measured with less accuracy at E_p = 11 Mev. The S-wave phase shift varies with energy as if scattering took place from a hard sphere of radius about 2.5 fm, whereas the P-wave phase shifts are well described by the effects of the ground and first excited states in ^{5}Li, calculated using single-level dispersion theory. The spin polarization of the scattered protons was calculated from the phase shifts and is in satisfactory agreement with experimental results from other laboratories. (auth)

19012 THE ELASTIC SCATTERING OF PROTONS FROM He^3 FROM 4.5 TO 11.5 Mev. T. B. Clegg, A. C. L.

Barnard, J. B. Swint, and J. L. Weil (Rice Univ., Houston, Tex.). Nucl. Phys., 50: 621-8(Jan. 1964). (TID-19042)

^{3}He(p,p)^{3}He cross sections were measured for incident proton energies from 4.5 to 11.5 Mev. Excitation functions at center-of-mass angles of 90°, 125°18′ and 161°12′ were measured from 4.5 to 10.4 Mev in steps of 200 kev, and no sharp structure was observed. Angular distributions were measured from 27°38′ to 166°35′ in the center-of-mass system at bombarding energies of 4.55, 5.51, 6.52, 7.51, 8.51, 9.51, 10.38, and 11.48 Mev. A phase shift analysis was made of these data using one phase shift for each of the values of l through l = 2. The P-wave phase shift was found to be increasing with energy (in qualitative agreement with earlier analyses). Cross sections calculated from the phase shifts show large deviations from the experimental values in the region around 100° in the center-of-mass system. This indicates that some spin-dependent splitting of the phase shifts is required to fit the data. (auth)

19013 THE SCATTERING OF He^3 BY He^4. A. C. L. Barnard, C. M. Jones, and G. C. Phillips (Rice Univ., Houston, Tex.). Nucl. Phys., 50: 629-40(Jan. 1964). (TID-19043)

Cross sections for the elastic scattering of ^{3}He by ^{4}He were measured for incident ^{3}He energies in the range $2.5 \leq E_{He^3} \leq 5.7$ Mev. Excitation functions were measured at center-of-mass angles 54°44′, 63°27′, 73°57′, 90°2′, 104°38′, 106°36′, 116°37′, 125°19′, and 140°50′. Angular distributions were measured at E_{He^3} = 2.467, 3.600, 4.761, and 5.703 Mev. The scattering phase shifts were obtained from these data. The general trend of the S-wave phase shift with energy is similar to that for hard-sphere scattering with a radius R = 2.8 fm. The variation of the δ_1^+ phase shift with energy is consistent with the effect of the ^{7}Be ground state, calculated using single-level dispersion theory. However, the behavior of the δ_1^- phase shift cannot be explained only by the effect of the ^{7}Be first excited state. The presence of the second excited state in ^{7}Be explains the behavior of the δ_2^+ phase shift fairly well. The parameters used for this state were $J^\pi = \frac{7}{2}^-$, R = 4.4 fm, characteristic energy = 3.56 Mev, reduced width = 0.7 Mev. (auth)

19014 DECAY OF Pm^{151}. U. Bertelsen (Univ. of Copenhagen), G. T. Ewan, and H. L. Nielsen. Nucl. Phys., 50: 657-83(Jan. 1964).

The disintegration scheme of Pm^{151} was studied by conversion electron-gamma and beta-gamma coincidence techniques. The internal conversion electron spectrum was also studied at 0.05% resolution. Fifty-seven transitions have been observed between levels in Sm^{151}. Levels are established in Sm^{151} at 0, 4.8, 65.8, 69.7, 91.5, 104.8, 167.7, 168.4, 209.0, 323.9, 344.9, 445.8, 745, 823, and 875 kev. The relative parities of the levels were established from the multipolarities of transitions between levels. The total decay energy determined by beta-gamma coincidence experiments is 1188 ± 10 kev. (auth)

19015 ANGULAR DISTRIBUTIONS OF GAMMA-RAYS FROM (n,n′γ) REACTIONS IN Mg^{24} AND Fe^{56}. D. J. Donahue and R. D. Roberts (Pennsylvania State Univ., University Park). Nucl. Phys., 50: 641-7(Jan. 1964).

The 1.37 Mev γ rays emitted in $2^+ \rightarrow 0^+$ transitions in Mg^{24}, the 0.85 Mev γ-rays from $2^+ \rightarrow 0^+$ transitions in ^{56}Fe, and the 1.24 Mev γ-rays from $4^+ \rightarrow 2^+$ transitions in ^{56}Fe were studied. Fast neutrons from a reactor were used to excite the target nuclei, and the relative yields of γ rays were measured as a function of the angle between the incident neutrons and the outgoing γ rays. Good agreement is obtained between measured angular distributions and distributions calculated using a statistical model. (auth)

19016 THE ELECTRON CAPTURE RATIO IN THE DECAY OF I^{125}. H. Leutz and K. Ziegler (Universität, Heidelberg). Nucl. Phys., 50: 648-56(Jan. 1964).

The ratio of captures from L- and higher atomic shells to K-electron capture of I^{125} was determined to be 0.2543 ± 0.0027. The I^{125} source was a constituent of the NaI-lattice in NaI(Tl) scintillation crystals. A mass difference of (148.9 ± 1) kev between the I^{125} and Te^{125} ground states was calculated from the obtained capture ratio. The measured decay curve of ^{125}I yields a half life of (60.25 ± 0.06) days. (auth)

19017 THE SCATTERING OF NEUTRONS BY POLARIZED DEFORMED NUCLEI. R. C. Barrett (Clarendon Lab., Oxford). Nucl. Phys., 51: 27-32(Feb. 1964).

The azimuthal asymmetry in the differential cross section for the scattering of 1-Mev neutrons by polarized ^{165}Ho is calculated in the adiabatic approximation using the rotational optical model. The relative asymmetry in both the direct elastic and inelastic cross sections is found to be considerable. (auth)

19018 INFLUENCE OF PAIRING CORRELATIONS ON NUCLEAR LEVEL DENSITIES. G. Kluge (Technische Hochschule, Darmstadt, Ger.). Nucl. Phys., 51: 41-9 (Feb. 1964).

The influence of pairing correlations on the level density of a nucleus is studied by employing a Fermi gas model with equally spaced single-particle levels and treating the pairing interactions in the superconductivity formalism of Belyaev and others. A numerical counting procedure is carried out to obtain deviations from the statistical formula for low excitation energies. (auth)

19019 A STUDY OF SOME (t,p) REACTIONS. I. METHOD AND RESULTS FROM Li^7, B^{10} AND B^{11}. R. Middleton (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.) and D. J. Pullen. Nucl. Phys., 51: 50-62(Feb. 1964).

Targets of ^{7}Li, ^{10}B, and ^{11}B were bombarded with 10- and 11-Mev tritons, and angular distributions of the protons from the (t,p) reaction were measured. The Q-value for the ^{7}Li(t,p)^{9}Li reaction was found to be −2.397 ± 0.020 Mev, and the excitation energy of the first excited state 2.691 ± 0.005 Mev. The ground-state proton distribution could only be fitted with plane wave double stripping theory if the two neutrons were assumed captured with a mixture of L = 0 and L = 2 orbital angular momenta. This is consistent with the expected spin-parity of $\frac{3}{2}^-$. Measurements of the proton distributions from ^{10}B(t,p)^{12}B were made for the ground and first eleven excited states of ^{12}B. Satisfactory agreement was obtained with plane wave theory expect for the ground state, which could not be accounted for by the required L = 2 transition. In contrast the ^{11}B(t,p)^{13}B ground state transition was well described by theory assuming L = 0. Nine excited states of ^{13}B were also observed and information on the spins and parities for six of them were obtained. (auth)

19020 A STUDY OF SOME (t,p) REACTIONS. II. RESULTS FOR C^{12}, C^{14}, O^{16} AND O^{18}. R. Middleton (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.) and D. J. Pullen. Nucl. Phys., 51: 63-76 (Feb. 1964).

Proton angular distributions from the (t,p) reaction were measured using targets containing ^{12}C, ^{14}C, ^{16}O, and ^{18}O. Good agreement is obtained in most cases with plane-wave double-stripping theory, although transitions to some excited states in ^{14}C probably proceed by a more complex

reaction mechanism. The spin-parity for ^{18}C was confirmed to be 0^+ and the first excited state, observed at 1.753 ± 0.012 Mev excitation, is probably 2^+. Angular distributions were measured for the ground and nine excited states of ^{18}O and ground and four excited states of ^{20}O. Only one state, at 4.45-Mev excitation in ^{18}O, could not be interpreted by a double stripping process. Comparisons with recent shell model calculations suggest that this state may be either 3^+ arising from the $d_{\frac{5}{2}} s_{\frac{1}{2}}$ configuration or 1^- from the $(1p)^{-1}(2s,1d)^3$ configuration. (auth)

19021 A STUDY OF SOME (t,p) REACTIONS. III. RESULTS FOR Mg^{26}, Si^{28}, Si^{29}, Ca^{40} AND Cd^{110}. R. Middleton (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.) and D. J. Pullen. Nucl. Phys., 51: 77-87 (Feb. 1964).

Targets containing ^{26}Mg, ^{28}Si, ^{29}Si, ^{40}Ca, and ^{110}Cd were bombarded with tritons of about 10 Mev. In many cases excellent agreement was obtained between the measured proton angular distributions from the (t,p) reactions and the predictions of plane-wave double-stripping theory. The $^{26}Mg(t,p)^{28}Mg$ reaction provided unambiguous determinations of the spins and parities of a number of states in ^{28}Mg that were previously unknown. Spin-parity assignments from the reactions $^{28}Si(t,p)^{30}Si$, $^{29}Si(t,p)^{31}Si$, and $^{40}Ca(t,p)^{42}Ca$ are in good agreement with earlier measurements. In the case of the $^{110}Cd(t,p)^{112}Cd$ reaction, an intense ground state transition was observed with relatively weak transitions to excited states. This may indicate the presence of an enhancement effect of the type suggested by Yoshida. (auth)

19022 TRITON ELASTIC SCATTERING FROM LIGHT NUCLEI. D. J. Pullen (Oxford Univ.), J. R. Rook, and R. Middleton. Nucl. Phys., 51: 88-95(Feb. 1964).

Differential cross sections were measured for 6.4-, 6.8-, and 7.2-Mev tritons elastically scattered from ^{12}C, ^{16}O, ^{18}O, ^{19}F, and ^{40}Ca, and attempts were made to analyze these results with the optical model. Although this model gives a good account of the scattering from ^{19}F and ^{40}Ca, the optical parameters are ambiguous. The theory is inadequate in explaining the scattering from ^{12}C, ^{16}O, and ^{18}O, and attempts to remove the discrepancies by the inclusion of spin-orbit and strong-coupling terms in the scattering formalism have proved unsuccessful. In the case of triton scattering from ^{16}O, the distributions exhibit a large backward peak suggestive of compound resonance scattering. (auth)

19023 THEORETICAL STUDY OF (t,p) REACTIONS. J. R. Rook and D. Mitra (Oxford Univ.). Nucl. Phys., 51: 96-112(Feb. 1964).

The zero-range distorted wave theory of the (t,p) stripping reaction is formulated and compared with recent experimental data. Fair agreement is obtained, but this is probably because the reaction mechanism is direct rather than due to the validity of the stripping assumption. The finite range theory is investigated in an approximation that reduces to the usual cut-off theory and is found to be important. A qualitative discussion is given of the competing two stage process. (auth)

19024 THE CHARGE DEPENDENCE OF NUCLEAR FORCES AND $\Delta T = \pm 1$ FERMI TRANSITIONS. R. J. Blin-Stoyle (Univ. of Sussex, [Brighton], Eng.) and L. Novakovic. Nucl. Phys., 51: 133-44(Feb. 1964).

Measurements of the β-γ circular polarization in the $\Delta T = \pm 1$ decays of ^{24}Na, ^{41}Al, ^{46}Sc, and ^{52}Mn enable experimental values of the Fermi matrix elements M_F, to be deduced. These values are compared with theoretical expressions for M_F calculated on the jj-coupled shell model and including a short-range charge dependent internucleon potential in addition to the usual coulomb potential. The results are consistent with a few per cent charge-dependence of nuclear forces, and with the conserved vector current theory of weak interactions. (auth)

19025 MULTIPOLE MOMENTS OF A ROUNDED CHARGE-DISTRIBUTION. L. W. Owen and G. R. Satchler (Oak Ridge National Lab., Tenn.). Nucl. Phys., 51: 155-60(Feb. 1964).

The multipole moments of a diffuse-edge charge distribution were calculated and compared to those obtained for a uniform, or "square", distribution. It is shown that serious errors may arise if a single "equivalent uniform" radius is used to compute these quantities. (auth)

19026 (d,p) STRIPPING REACTION AND (d,d) ELASTIC SCATTERING ON Cr^{50}, Cr^{52}, Cr^{53}, Cr^{54}, AND Fe^{54}, Fe^{56}, AND Fe^{57}. V. P. Bochin, K. I. Zherebtsova, V. S. Zolotarev, V. A. Komarov, L. V. Krasnov, V. F. Litvin, Yu. A. Nemilov, B. G. Novatskii, and Sh. Piskorzh (Leningrad State Univ.). Nucl. Phys., 51: 161-73(Feb. 1964).

A method is described for determining the absolute differential cross sections for reactions using a multiangle magnetic analyzer. The energy spectra and angular distributions of protons from the (d,p) reactions on the targets of enriched $^{50,52,53,54}Cr$ and $^{54,56,57}Fe$ are studied. Altogether 153 levels of final nuclei are studied, including 48 new ones. The l and Θ^2 values are obtained for 93 levels, including 58 new ones. A well-pronounced dependence of the cross sections for the (d,p) reaction on the parameter of the target nucleus symmetry is established. The occupation numbers of the neutron 2p subshell are found from the treatment of the experimental data using the sum rule and the results are compared with other data concerning the (d,t) reaction. The isobaric spin constant of the nuclear optical potential is estimated by the shift of single-particle neutron levels after the addition of two neutrons. 26 references. (auth)

19027 DECAY OF ^{47}Sc. S. C. Misra, U. C. Gupta, and N. P. S. Sidhu (Atomic Energy Establishment, Trombay, India). Nucl. Phys., 51: 174-6(Feb. 1964).

The number of gamma rays per disintegration in the decay of ^{47}Sc were measured by an NaI(Tl) scintillation spectrometer and a 4π beta proportional counter. The 163-kev gamma rays were found to be 73% of the total disintegration rate. (auth)

19028 THE EMISSION OF PHOTONEUTRONS FROM NATURAL LITHIUM. F. R. Allum, G. M. Crawley, and B. M. Spicer (Univ. of Melbourne). Nucl. Phys., 51: 177-92(Feb. 1964).

The photoneutron yield curve of natural lithium was determined for incident bremsstrahlung energies up to 18.5 Mev. This yield curve shows no gross structure in the region of 17 Mev as indicated in some previous measurements. The resulting cross section indicates the presence of three high energy levels in ^7Li at 13.6, 15.3, and 16.5 Mev. Additional measurements using a neutron detection system with a response deliberately designed to be sensitive to slow neutrons were made simultaneously with the above yield curve determination. This "slow neutron" yield curve suggests that the discrepancies among the earlier results may be due to the different responses of the various neutron detection systems used. An outline of a possible test to verify this suggestion is given. (auth)

19029 MEASUREMENT OF (p,γ) ANGULAR CORRELATIONS IN THE REACTIONS $Be^9(d,p)Be^{10}$ (3.37 Mev) AND $Ca^{40}(d,p)Ca^{41}$ (1.95 Mev) AT E_d = 6.6 Mev. J. Zamu-

dio C., R. Achari, and P. Roussel (Faculté des Sciences, Paris). Nucl. Phys., 51: 212-24(Feb. 1964). (In French)

Measurements of (p,γ) angular correlation in deuteron stripping reaction using ^{9}Be and ^{40}Ca targets were made at 6.6 Mev. In both reactions, correlations were measured in the reaction plane and in a plane normal to the reaction plane, for the first excited state of the final nucleus. The correlations obtained were used to test the predictions of Huby, Refai, and Satchler in the distorted wave theory without a spin-orbit term in the potential. Results indicate an important contribution of neglected terms. (auth)

19030 ENERGY LEVELS OF Cr^{52} AND Ca^{44}. T. Komoda (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Phys., 51: 234-43(Feb. 1964).

The energy levels of the $f_{\frac{7}{2}}$ nuclei with four nucleons outside the closed shell are calculated using configuration mixing. The effective interactions between particles were calculated using both the Rosenfeld and the Serber type of exchange. The calculated energy levels agree fairly well with the experimental levels of ^{52}Cr for values of the range parameter $1.0 < \lambda < 1.5$ for both effective interactions. With configuration interaction the states with seniority $v = 2$ and 4 are mutually mixed through intermediate states of other configurations. It is possible that this seniority mixing explains the radiative transitions to the low-lying $J = 4$ levels from the $J = 6$ level of ^{52}Cr. The M1 and E2 transitions are also calculated from the $J = 5$ level in ^{52}Cr. (auth)

19031 THE NUCLEAR STRUCTURE OF ^{24}Na AND SOME REMARKS ON THE NUCLEAR STRUCTURE OF ^{25}Mg. C. Daum (Univ. of Michigan, Ann Arbor). Nucl. Phys., 51: 244-72(Feb. 1964).

The experimental data on the ^{23}Na(d,p)^{24}Na reaction at E_d = Mev reported in a previous paper are used for a tentative interpretation of the even parity levels of ^{24}Na at low excitation. Comparison with the interpretation of the nuclear structure of ^{25}Mg leads to assignment of rotational bands in ^{24}Na. The spectroscopic data of the (d,p) reaction on ^{23}Na and ^{24}Mg and the position of the intrinsic states of the rotational bands in ^{24}Na and ^{25}Mg yield a reasonable fit to the unified model for $\beta \approx 0.2$ at $\kappa = 0.08$, to be contrasted with a value of $\beta \approx 0.4$ to 0.5 at $\kappa = 0.08$ deduced from the magnetic moment, the total energy of the nucleus in the Nilsson model, and the quadrupole moments of nuclei in this region. The The rotation-particle coupling distorts the rotational structure of ^{24}Na and ^{25}Mg considerably. The unified model alone and this model including a residual central two-body interaction between the two odd nucleons predict a ground state spin 1^+ instead of 4^+ for ^{24}Na. Taking into account a two-body spin-orbit force and a tensor force may yield a correct prediction of the ground state spin. (auth)

19032 CROSS SECTION OF THE REACTION $^{31}_{15}$P(n,2n)$^{30}_{15}$P WITH NEUTRONS OF ENERGY 14.8 Mev. B. Grimeland and P. Opsahl-Andersen (Univ. of Oslo). Nucl. Phys., 51: 302-6(Feb. 1964).

Phosphorus was irradiated with 14.8-Mev neutrons and the spectrum of gamma rays emitted after the irradiation was analyzed. The ratio between the cross sections of the reactions ^{31}P(n,2n)^{30}P and ^{31}P(n,α)^{28}Al was determined to be 0.087 ± 0.006. With the (n,α) cross section equal to 98 ± 12 mb, this leads to a value of 8.5 ± 1.2 mb for the (n,2n) cross section. (auth)

19033 THE (2I + 1) RULE APPLIED TO THE (d,α) REACTIONS ON Mg^{25} AND Al^{27}. O. Hansen, E. Koltay, N. Lund, and B. S. Madsen (Universitet, Copenhagen). Nucl. Phys., 51: 307-11(Feb. 1964).

The correlation between the total cross section for (d,α) reactions to definite states in ^{23}Na and ^{25}Mg and the spin I of these states was investigated experimentally. Bombarding energies from 3.35 to 3.80 Mev and (in the ^{23}Na case) from 7.1 to 7.7 Mev were employed. In the latter region the total cross sections, when averaged over bombarding energy, were observed to be approximately proportional to (2I + 1). This empirical relation is used to deduce the spin values for 7 excited states in ^{23}Na. The ^{23}Na level scheme is briefly discussed in terms of the rotational model. (auth)

19034 ELECTRO-PRODUCTION OF PIONS FROM NUCLEI. W. Czyż and J. D. Walecka (Stanford Univ., Calif.). Nucl. Phys., 51: 312-20(Feb. 1964).

The contribution of pion production to inelastic electron scattering from nuclei through a given angle and with a given energy loss was calculated. The amplitude for the production from a single nucleon is taken from the work of Fubini, Nambu, and Wataghin. A Fermi gas model of the nuclear excitation spectrum is used in order to carry out the sum over final nuclear states. Both incoherent and coherent production are included. The cross sections are computed for energy losses above meson threshold and below the (3,3) resonance. Since the results are strongly dependent on the model of the excitation spectrum such experiments can give valuable information about nuclei. (auth)

19035 ANGULAR DISTRIBUTIONS OF THE ^{19}F(d,p)^{20}F REACTION AND ANGULAR MOMENTUM ASSIGNMENTS TO EXCITED STATES OF ^{20}F. M. E. O. De López, J. Rickards, and M. Mazari (Universidad Nacional Autónoma de Mexico, Mexico City). Nucl. Phys., 51: 321-8(Feb. 1964).

The ground and fourteen excited states of ^{20}F were analyzed through (d,p) reactions in ^{19}F. The use of a double broad-range magnetic spectrograph technique provides a marked improvement in the angular distributions obtained. At least twelve of these angular distributions show definite stripping patterns. Neutron capture angular momenta $l_n = 2$ could be assigned to the ground, first, fifth, eighth, and ninth excited states of ^{20}F; $l_n = 0$ values could be associated to levels 2, 4, 7, 10, 11, 12, 13, 14, and 15. (auth)

19036 (n,2n) EXCITATION CROSS SECTION MEASUREMENTS FOR 14.8-Mev NEUTRONS ON Eu^{151}, Er^{170}, Yb^{176}, AND Tl^{205}. Hans Spenke (Inst. for Radium Research and Nuclear Physics, Austrian Academy of Sciences, Vienna). Nucl. Phys., 51: 329-36(Feb. 1964). (In German)

Absolute β-counting with liquid scintillators was used to determine (n,2n) cross sections by the activation method. New methods are given of preparing the salts of the octoic acid, directly soluble in the liquid scintillator. The following results were found: ^{151}Eu(n,2n)^{150}Eu: σ = 480 mb + 13%; ^{170}Er(n,2n)^{169}Er: σ = 1895 mb ± 7%; ^{176}Yb(n,2n)^{175}Yb: σ = 1810 mb ± 7%; ^{205}Tl(n,2n)^{204}Tl: σ = 1990 mb ± 7%. (auth)

19037 THE MEASUREMENT BY ACTIVATION OF CROSS SECTIONS FOR 14.7 Mev NEUTRONS. G. C. Bonazzola (Istituto Nazionale de Fisica Nucleare, Turin), P. Brovetto, E. Chiavassa, R. Spinoglio, and A. Pasquarelli. Nucl. Phys., 51: 337-44(Feb. 1964).

Measurements of some cross sections for reactions induced by fast neutrons are described. The technique employed was that of detecting the induced beta activity in the target material. Special care was taken to reduce

experimental errors. Results are given for (n,α) reactions with ^{27}Al, (n,p) reactions with ^{27}Al, ^{56}Fe, and ^{65}Cu, and (n,2n) reactions with ^{65}Cu, ^{110}Pd, ^{128}Te, ^{130}Te, and ^{165}Ho. 20 references. (R.E.U.)

19038 THE FORWARD PEAKING OF FAST PHOTONEUTRON ANGULAR DISTRIBUTIONS. T. W. Quirk and B. M. Spicer (Univ. of Melbourne). Nucl. Phys., 51: 345-52(Feb. 1964).

A mechanism, involving one neutron-proton scattering, is proposed to explain the forward asymmetry of fast photoneutron angular distributions. (auth)

19039 EFFECTS OF NUCLEAR ORIENTATION AND ELECTRON POLARIZATION IN ELECTRO-EXCITATION OF NUCLEI. L. J. Weigert and M. E. Rose (Univ. of Virginia, Charlottesville). Nucl. Phys., 51: 529-52(Mar. 1964).

The differential cross section for electro-excitation of nuclei and the polarization of the scattered beam are presented for an oriented target and/or polarized incident electrons. The electron states are represented by plane waves. Transitions of arbitrary multipolarity are considered, and both the Coulomb and the transverse parts of the interaction are taken into account. Experiments with aligned targets can be used to determine the reduced nuclear matrix elements contributing to a mixed (EL, ML ± 1) transition. The change in the electron polarization vector by inelastic scattering from an unoriented target is discussed in some detail for the cases of pure Coulomb and pure transverse scattering. (auth)

19040 THE (n,α) REACTION ON C^{12} AT 14 Mev. M. L. Chatterjee and B. Sen (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Phys., 51: 583-7(Mar. 1964).

The ^{12}C(n,α)^{9}Be reaction leading to the ground state of ^{9}Be was studied using nuclear emulsions. The angular distribution of the emitted group of alphas is found to be asymmetric about 90° c.m. and indicates the presence of direct interaction. The distribution shows a prominent forward peak at about 30° and a comparatively slow rise in the backward direction. The total cross section for the ground state transition is 69 ± 13 mb. The theoretical fits to the experimental angular distribution were discussed in terms of direct and exchange effects. (auth)

19041 THE CIRCULAR POLARIZATION OF EXTERNAL BREMSSTRAHLUNG PRODUCED BY β RAYS IN A MAGNETIZED IRON TARGET. I. Khubeis and H. Schopper (Technische Hochschule, Karlsruhe, Ger. and Kernforschungszentrums, Karlsruhe, Ger.). Nucl. Phys., 51: 588-92(Mar. 1964).

The degree of the circular polarization of external bremsstrahlung produced by β rays from a ^{90}Sr + ^{90}Y source in an iron target was investigated with the target magnetization perpendicular to the momentum of the electrons. No variation of the circular polarization as a function of the magnetization was found in disagreement with the results of Bisi et al. (auth)

19042 LEVELS IN Na^{23} FROM THE ALPHA BOMBARDMENT OF F^{19}. R. M. Freeman and G. S. Mani (CEN, Saclay, France). Nucl. Phys., 51: 593-603(Mar. 1964).

The yield of seven gamma rays following the alpha bombardment of ^{19}F was studied for bombarding energies ranging from 2 to 5 Mev. A number of new resonances were observed, corresponding to excited levels in ^{23}Na, in the region not previously studied for alpha energies above 3.5 Mev. (auth)

19043 A 0.46-μs ISOMER IN Gd^{157}. J. Kantele, K. M. Broom, and D. M. Chittenden, II (Univ. of Arkansas, Fayetteville). Nucl. Phys., 51: 604-8(Mar. 1964).

A 0.46 μs isomeric state in ^{157}Gd was observed in scintillation spectrometric studies of the decay of ^{157}Eu. The excitation energy of the isomer was found to be 65 ± 2 kev. Therefore, this state probably can be identified with the 64.0 kev [642] Nilsson level in ^{157}Gd reported earlier. The decay of the 0.46 μs state is studied and discussed. (auth)

19044 STUDY OF MU-MESONIC X-RAYS: ELEMENTS FROM SULPHUR TO MOLYBDENUM. D. Quitmann (Technische Hochschule, Darmstadt, Ger.), R. Engfer, U. Hegel, P. Brix, G. Backenstoss, K. Goebel, and B. Stadler. Nucl. Phys., 51: 609-33(Mar. 1964).

For twelve elements between sulfur and molybdenum, the energy of the mu-mesonic 2p-1s transition and the difference of these energies for neighboring elements were measured. Special care was taken to reduce and to study systematic errors, and the measurements were repeated under different conditions. Some of the control measurements and the data analysis are described. Background spectra are reported. The mu-mesonic 2p-1s energies agree well with those calculated under the assumption that the maximum density of nuclear matter and the surface thickness are constant for the nuclei studied. The intensities of the 3p-1s transition and of an unresolved group of higher K lines were evaluated relative to the 2p-1s line. (auth)

19045 STATISTICAL THEORY OF FISSION AND FISSION ASYMMETRY. V. S. Stavinsky (Atomic Energy Establishment, Cairo). Nucl. Phys., 51: 634-40(Mar. 1964).

The statistical theory of Bohr and Wheeler is used for the explanation of fission asymmetry. It is shown that the observable fission asymmetry is determined mainly by the number of degrees of freedom of the fissile nucleus at the moment of rupture. Good agreement is obtained with experimental data. (auth)

19046 ENERGY LEVELS FROM (p,p'), (d,p) AND (d,α) REACTIONS ON THE STABLE ISOTOPES BETWEEN Sc^{45} AND Ni^{58}. J. H. Bjerregaard, P. F. Dahl, O. Hansen, and G. Sidenius (Universitet, Copenhagen). Nucl. Phys., 51: 641-66(Mar. 1964).

Isotope separated targets of all the stable nuclei between ^{45}Sc and ^{58}Ni were bombarded with protons and deuterons of energies between 3 and 4.3 Mev. The protons, deuterons, and α particles from the reactions were recorded in a heavy particle spectrograph. The Q values and excitation energies were determined. The cross sections observed in the (p,p'), (d,p), and (d,α) reactions yield information on the reaction mechanisms involved, and from the (d,p) intensities a number of $p_{\frac{1}{2}}$ states are suggested. The main trends of the nuclear level schemes are discussed qualitatively on the basis of the shell model with residual interactions. (auth)

19047 MEASUREMENT OF THE γ-γ DIRECTIONAL CORRELATION OF 426-404 kev CASCADE IN THE DECAY OF Pb^{211}. Mario Uhl (Institut für Radiumforschung und Kernphysik, Vienna). Nucl. Phys., 51: 667-72(Mar. 1964). (In German)

The γ-γ-directional correlation of the 426-404 kev cascade in the decay of ^{211}Pb was studied with a coincidence scintillation spectrometer. Measurements were performed with a liquid and a solid source. The observed coefficients of the correlation function are presented. Since the measured conversion coefficients allow M1 and E2 mixtures in both transitions it was not possible to make a unique assignment. (auth)

19048 DETERMINATION OF SOME ENERGY LEVELS IN LIGHT- AND MEDIUM-WEIGHT NUCLEI WITH A PRECISION GAMMA RAY SCINTILLATION SPECTROMETER.

K. W. Marlow (Naval Research Lab., Washington, D. C.). Nucl. Phys., 51: 684-9(Mar. 1964).

A stabilized scintillation spectrometer was used to measure the energy of gamma rays emitted from the following reactor-neutron-produced radioactive sources: ^{28}Al, ^{38}Cl, ^{42}K, ^{124}Sb, ^{66}Ni, ^{66}Cu, ^{88}Rb, and ^{52}V. The energy determinations were made with an accuracy of the order of 1 kev, an improvement of an order of magnitude in several cases. (auth)

19049 THE DECAY OF THE SECOND 2^+ LEVEL IN Fe^{58}. S. Malmskog (Aktiebolaget Atomenergi, Studsvik, Sweden). Nucl. Phys., 51: 690-4(Mar. 1964).

Using a fast-slow coincidence system the intensity ratio between the crossover and cascade transitions from the second 2^+ level in ^{58}Fe was determined to be 0.44 ± 0.05. An angular correlation measurement on the 864.8 and 810.5 kev gamma cascade from the second 2^+ level in ^{58}Fe is consistent with a $2^+(E2 + M1)2^+(E2)0^+$ cascade giving a mixing ratio $\delta = +1.6 \pm 0.2$. (auth)

19050 THE STRUCTURE OF THE GIANT DIPOLE RESONANCE. I. PROTON CAPTURE BY LIGHT NUCLEI. N. W. Tanner, G. C. Thomas, and E. D. Earle (Oxford Univ.). Nucl. Phys., 52: 29-44(Mar. 1964).

The giant dipole resonances of several light nuclei were studied by using the inverse (p,γ) reaction. Good energy resolution was achieved by using the proton beam of a Tandem Electrostatic Generator. The excitation functions at 90° to the beam for the γ rays leading to the ground state are presented for the reactions ^{7}Li$(p,\gamma)^8$Be, ^{19}F$(p,\gamma)^{20}$Ne, and ^{39}K$(p,\gamma)^{40}$Ca. The excitation function for γ rays to the first excited state is also given for ^{7}Li$(p,\gamma)^8$Be and ^{19}F$(p,\gamma)^{20}$Ne. Data by other workers on proton capture in the region of the dipole resonance are assembled and briefly reviewed. The light nuclei ^{4}He and ^{8}Be show no structure; generally, the structure increases in amount and decreases in width as the heaviness of the nucleus being studied increases. The main features of the shell-model calculations for the simple nuclei, ^{12}C and ^{16}O, are confirmed but there is more detail than is yet predicted by theory. The dipole resonance based on the first excited state of several nuclei is displaced upwards in energy by the excitation energy of the state. 45 references. (auth)

19051 THE STRUCTURE OF THE GIANT DIPOLE RESONANCE. II. DIPOLE STATES IN O^{16}. N. W. Tanner, G. C. Thomas, and E. D. Earle (Oxford Univ.). Nucl. Phys., 52: 45-60(Mar. 1964).

The giant dipole resonance in ^{16}O was studied in detail using the inverse proton capture reaction ^{15}N$(p,\gamma)^{16}$O. A tandem accelerator was used to provide a proton beam in the energy range 4 to 14.4 Mev (^{16}O excitation from 15.9 to 25.6 Mev), which bombarded a gas target of $^{15}_{7}$N. The capture radiation was analyzed with a sodium iodide scintillation counter. The yield curve of ^{15}N$(p,\gamma)^{16}$O exhibits considerable structure in good agreement with contemporary studies of the groups of particles from the photodisintegration of ^{16}O, and in some agreement with the ^{15}N$(p,n)^{15}$O reaction. Limited agreement with the "breaks' observed in the bremsstrahlung yield curve is noted. The structure of the giant resonance in ^{16}O is interpreted in terms of individual resonances. The excitation energies of the more prominent resonances are in good agreement with the predictions of the shell-model calculations but in order to compare the relative cross sections of experiment and theory favorably the experimental resonances must be grouped. 43 references. (auth)

19052 INTERNAL CONVERSION COEFFICIENTS OF THE TRANSITIONS IN W^{182}. E. Bashandy, A. H. El-Farrash, and M. S. El-Nesr (Atomic Energy Establishment, Cairo). Nucl. Phys., 52: 61-78(Mar. 1964).

The conversion electron spectrum of ^{182}W was measured by means of an iron-yoke double-focusing spectrometer. By careful analysis of the conversion spectrum, which was recorded at a resolution of about 0.28%, it was possible to identify two additional new transitions of 146 and 351 kev gamma rays not reported before. Multipolarities and mixing ratios were determined from K/L or L-subshell ratios for low-energy transitions. The determined conversion coefficients generally support previous spin assignments. The 116-kev gamma transition was found to be an electric dipole transition, while the 146-kev gamma ray has magnetic quadrupole character. New levels at 680 and 1437 kev with spin and parity 6^+ and 4^+, respectively, were confirmed. No penetration effects were found in the conversion process of the retarded 67-, 116-, and 222-kev E1 transitions. However, the retarded 152-, and 156-kev electric dipole transitions showed an anomalous internal conversion coefficient deviating about 20% from the theoretical values for pure E1 transitions calculated by Sliv and Band. (auth)

19053 INVESTIGATION OF THE NUCLEAR MATRIX ELEMENT PARAMETERS FOR FIRST-FORBIDDEN BETA DECAY. Harry Dulaney, C. H. Braden, and L. D. Wyly (Georgia Inst. of Tech., Atlanta). Nucl. Phys., 52: 79-92 (Mar. 1964).

An analysis was made of first forbidden beta groups of ^{186}Re, ^{188}Re, ^{170}Tm, ^{152}Eu, ^{154}Eu, and ^{124}Sb. The available experimental data were used to determine suitable values for the nuclear matrix elements for each transition. The areas of agreement that exist between the experimentally determined matrix elements and the theoretical relations that are proposed for the matrix elements were investigated. An attempt was made to establish an experimental estimate for the parameter A (Ahrens' and Feenberg's notation). The following conclusions were reached: (1) The presently available experimental data alone do not determine well defined matrix elements for any of the transitions. (2) Taken as a whole, the decays considered provide no conclusive evidence for a particular value of A. (3) However, for the decays considered, if it is assumed that $A \approx 2.5$ a well defined solution that is compatible with the assumptions of the "modified B_{ij} approximation" is produced. 34 references. (auth)

19054 OPTICAL MODEL ANALYSIS OF THE ELASTIC SCATTERING OF 12.29 Mev PROTONS BY Cu^{63} AND Cu^{65}. R. N. Thomas (Univ. of London), E. J. Burge, and P. E. Hodgson. Nucl. Phys., 52: 93-103(Mar. 1964).

A detailed optical model analysis is made of the elastic scattering of protons by ^{63}Cu and ^{65}Cu. A good fit is obtained for both isotopes using the Saxon-Woods form factor for the real and imaginary parts of the potential. Surface peaking of the imaginary part and extension of the imaginary parts beyond the real part of the potential lead to a deterioration in the quality of the fit. The reaction cross section measurements do not determine the radial distribution of the imaginary part of the potential. The difference between the elastic cross sections of the two isotopes cannot be attributed to a change in only one optical model parameter, but the isobaric spin dependence of the real part of the central potential was investigated and the results are consistent with values reported elsewhere. (auth)

19055 THE REACTION ^{30}Si$(\alpha,\gamma)^{34}$S. C. van der Leun and G. Wiechers (Rijksuniversiteit, Utrecht). Nucl. Phys., 52: 104-13(Mar. 1964).

In the energy range $E_\alpha = 2.10$ to 3.25 Mev, twenty-three

resonances are reported from radiative alpha capture in ^{30}Si. For the thirteen strongest resonances, the main modes of decay and the resonance strengths are given. Angular distribution and angular correlation measurements yield the spin and parity of nine 1^- resonances and of three 2^+ resonances. Comparison of the radiative widths of E1 transitions in the compound nucleus ^{34}S, as calculated from the measured resonance strengths, with those of analogous E1 transitions in ^{32}S, indicates that in this mass-region the isobaric-spin selection rule inhibits the E1 transition speed in self-conjugate nuclei by about one order of magnitude. (auth)

19056 THE (t,p) REACTION AND NUCLEAR STRUCTURE OF O^{18} AND O^{20}. L. Trlifaj (Inst. for Theoretical Physics, Copenhagen). Nucl. Phys., 52: 114-24(Mar. 1964).

The experimental data from the ^{16}O(t,p)^{18}O and ^{18}O(t,p)^{20}O reactions are used to obtain relative information on the coupling schemes valid in the ground state of the ^{18}O and ^{20}O nuclei. The comparison with theory is based on the plane-wave Born approximation for double stripping. The pairing, SU_3, and aligned coupling schemes are examined. The pairing coupling scheme only seems to be excluded from the competition by experiment. (auth)

19057 DECAY OF Cu^{68}. H. Bakhru and S. K. Mukherjee (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Phys., 52: 125-33(Mar. 1964).

The decay of ^{68}Cu was studied after bombarding Zn and Ga with 14-Mev neutrons, using standard scintillation counter techniques. The beta and gamma measurements showed the presence of four gamma rays of energies 810 ± 8(18), 1080 ± 3(100), 1240 ± 10(3), and 1880 ± 10 kev (5), and three beta groups of maximum energies 3.5 ± 0.06 (75%), 2.7 ± 0.08(22%), and 2.25 ± 0.08 Mev(3%) decaying with a half life of 30 ± 1 sec. Coincidence and sum spectrum studies showed that the 1080-kev gamma ray was in cascade with the 800- and 1240-kev gamma rays, and that the 1080-kev gamma ray was in coincidence with 3.5-, 2.7- and 2.25-Mev beta particles. A decay scheme is proposed, and a ^{68}Cu–^{68}Zn mass difference of 4.58 Mev is obtained. (auth)

19058 DEUTERON-ALPHA ELASTIC SCATTERING. G. G. Ohlsen and P. G. Young (Australian National Univ., Canberra). Nucl. Phys., 52: 134-43(Mar. 1964).

Deuteron-alpha elastic scattering cross sections were measured over the deuteron energy range 3.5 to 10 Mev. The data are in the form of excitation functions at seven center-of-mass angles: 30.6, 40.7, 51.9, 76.2, 90.0, 125.3, and 139.1°. The data at 139.1° and part of the data at 125.3° were obtained by observing recoil alpha particles. Energy steps of about 50 kev and an energy resolution of about 30 kev were employed. The cross sections determined are accurate to about 3%. Above 5 Mev the cross sections vary slowly with energy. (auth)

19059 COLLECTIVE EXCITATIONS OF NUCLEAR MATTER FOR $N \neq Z$. Saburo Fujii (Univ. of Virginia, Charlottesville). Nucl. Phys., 52: 144-56(Mar. 1964).

Assuming an energy gap between proton and neutron in nuclear matter, collective excitations of nuclear matter are investigated. Two kinds of collective excitation are found, with a relation between energy and momentum given by $\Delta(q) = \eta + q^2/2m + \ldots$. A connection between the collective states and excited states of actual nuclei is shown. The damping of the collective states is also calculated. (auth)

19060 EFFECT OF NEUTRON SPECTRUM ON THE BRANCHING RATIO OF THE $Ni^{58}(n,p)Co^{58}$ REACTION. W. H. Martin (United Kingdom Atomic Energy Authority, Culcheth, Lancs, Eng.). Nucl. Sci. Eng., 18: 531-2(Apr. 1964).

Previous determinations of the branching ratio for production of ground- and isomeric-state ^{58}Co in the ^{58}Ni(n,p) reaction as a function of neutron energy are discussed. (C.E.S.)

19061 RECENT DEVELOPMENTS IN THE THEORY OF COMPLEX ANGULAR MOMENTA. T. Regge (Università, Turin). Nuovo Cimento (1), 1: Suppl. No. 1, 173-8(1963). (In Italian)

Recent refinements made to the theory of complex angular momenta are reviewed. The analysis of the experimental data on the scattering of α particles by ^{12}C in the light of this theory is discussed. (J.S.R.)

19062 GENERAL DISCUSSION ON LOW-ENERGY PHYSICS. E. Amaldi (Università, Rome). Nuovo Cimento (1), 1: Suppl. No. 1, 301-39(1963). (In Italian)

A survey is given of the recent major developments in the field of low-energy physics. The topics discussed are basic models of nuclear spectroscopy, use of nuclear reactions at relative high energies for the study of the shell model in light nuclei and in the correlation between nucleon pairs in light and medium nuclei, nuclear fission, nuclear reactions and elastic collisions, generalized optical model, calculation of the cross section of the direct nuclear reaction in the Born approximation with distorted wave, separation between the contributions from direct processes and evaporative processes, refinements to the theory of the continuum, determination of the mean life of highly excited states, first attempts at the measurement of the lifetime of a nuclear reaction, and the study of β-decay processes and the upper limit for the violation of conservation of parity in strong interactions. (J.S.R.)

19063 DIPOLE STATES IN OXYGEN 16. G. F. Nash (Wadham Coll., Oxford). Nuovo Cimento (10), 31: 992-7 (Mar. 1, 1964).

The single excitations in ^{16}O are classified by the SU(3) coupling scheme, and the binding energies of the groups of states calculated using a two-body force with a full exchange mixture. (auth)

19064 QUASI-ELASTIC $p-\alpha$ SCATTERING IN C^{12}, STUDIES WITH A BUBBLE CHAMBER. Phys. Letters, 8: 318-20(Mar. 1, 1964). (In French)

The reaction ^{12}C(p,pα)^{8}Be was investigated in conjunction with a study of the ^{12}C(p,2p)^{11}B reaction in a propane bubble chamber. Kinematic analysis of the events gave a binding energy of 7.5 ± 4 Mev for the (p,pα) reaction leaving the final nucleus in the ground state and further indicated that for 85-Mev incident protons, the reaction is quasi-elastic. The total effective cross section for the reaction was estimated to be ≤3 mb. Since the effective differential cross section varied rapidly, the probability of alpha substructures in the nucleus was determined by statistical means. (D.C.W.)

19065 A SEARCH FOR H^4, PROTONS FROM H^3(d,p). P. C. Rogers and R. H. Stokes (Los Alamos Scientific Lab., N. Mex.). Phys. Letters, 8: 320-1(Mar. 1, 1964).

The possible existence of particle-stable ^{4}H was studied in ^{3}H(d,p) reaction a E_d = 10 Mev. The proton energy spectra were measured but no peaks were observed from the ^{3}H(d,p)^{4}H reaction. The results are indicative of the nonexistence of particle-stable ^{4}H and that the ^{4}He excited state (20.2 Mev) has T = 0. (R.E.U.)

19066 PHOTODISINTEGRATION OF He^3 BY γ RAYS OF ENERGY BETWEEN 10 AND 30 Mev. C. Becchi, G. E. Manuzio, L. Meneghetti, and S. Vitale (INFN, Genoa;

CNEN, Genoa; and Università, Genoa). Phys. Letters, 8: 322-4(Mar. 1, 1964).

The cross section for two-body photodisintegration of ^{3}He was studied experimentally by two methods. The energy distribution of coincident charged particles emitted in opposite directions at 90° with respect to the gamma beam axis was analyzed, and in the second method, the charged particles emitted at 90° to the beam axis were detected with a telescope of two silicon junction detectors. Very good energy resolution was obtained. (R.E.U.)

19067 THE THEORY OF FLUCTUATIONS IN NUCLEAR REACTION CROSS SECTIONS. D. M. Brink and R. O. Stephen (Clarendon Lab., Oxford). Phys. Letters 8: 324-5(Mar. 1, 1964).

A Monte Carlo calculation of cross sections was carried out to illustrate probability density distribution, energy autocorrelation function, average number of maxima per unit energy, and the mean variation of a partial cross section. (R.E.U.)

19068 THE PENETRATION MATRIX ELEMENT OF THE 279 kev TRANSITION IN Tl^{203}. J. E. Thun, S. Toernkvist, F. Falk, H. Snellman, and F. Kropff (Uppsala Univ.). Phys. Letters, 8: 326-7(Mar. 1, 1964).

The penetration matrix elements (PME) that express the conversion probability within the nucleus are obtained from dynamic effects of the finite size of the nucleus in measurements of internal conversion coefficients and conversion electron directional correlation patterns. Electron–gamma coincidence measurements were made for the 279-kev transition in ^{203}Tl, which was obtained by electron capture decay of ^{203}Pb. (R.E.U.)

19069 ELASTIC AND INELASTIC SCATTERING OF ALPHA PARTICLES AT 23.8 Mev ON Li^6 AND Be^9. G. Gregoire and P. C. Macq (Universite, Louvain, Belg.). Phys. Letters, 8: 328-30(Mar. 1, 1964). (In French)

The angular distributions from (α,α') reactions with ^{9}Be and ^{6}Li at 23.8 Mev were determined. Cross section angular dependence is discussed. (R.E.U.)

19070 ELASTIC AND INELASTIC p–α COLLISIONS AT 55 Mev. S. Hayakawa, N. Horikawa, R. Kajikawa, K. Kikuchi, H. Hobayakawa, K. Matsuda, S. Nagata, and Y. Sumi (Nagoya Univ., Japan). Phys. Letters, 8: 330-2 (Mar. 1, 1964).

Differential cross sections were obtained for elastic p–α scattering and for ^{4}He(p,d)^{3}He reaction for 55-Mev protons. Reaction mechanisms are discussed. (R.E.U.)

19071 POLARIZATION OF NEUTRONS FROM THE REACTION D(d,n)He^3 AT LOW DEUTERON ENERGY. H. Haensgen, G. Schirmer, and D. Seeliger (Technische Universitat, Dresden). Phys. Letters, 8: 332(Mar. 1, 1964). (In German)

Right-left asymmetry was studied in the neutron distribution from D(d,n)^{3}He at E_d = 20 to 160 kev by scattering on ^{12}C of known polarization. Maximum polarization of 11.3% was found at 80 kev. (R.E.U.)

19072 ON AN EXCITED STATE OF He^4. S. Hayakawa, N. Horikawa, R. Kajikawa, K. Kikuchi, H. Kobayakawa, K. Matsuda, S. Nagata, and Y. Sumi (Nagoya Univ., Japan). Phys. Letters, 8: 333-4(Mar. 1, 1964).

The existence of an excited state at 22.5 Mev in ^{4}He was indicated by observing a group of inelastically scattered protons from a gas target of ^{4}He bombarded by 55-Mev protons. (R.E.U.)

19073 INTERACTION OF QUASI-PARTICLES AND VIBRATIONAL MODEL IN ISOTOPES OF NICKEL. R. Arvieu, E. Salusti, and M. Veneroni (Faculte des Sciences, Orsay, France). Phys. Letters, 8: 334-7 (Mar. 1, 1964). (In French)

The energy levels of even nickel isotopes ($58 \leq A \leq 66$) were calculated by the method of quasibosons. The results were compared with experimental values and with those from the diagonalization of the interaction in the subspace of configurations with two quasiparticles. The results from these approximations do not differ perceptibly, but they contradict the results of the vibrational model. The differences between the vibrational models and the more detailed description are discussed, together with the difficulties of the vibrational model. (D.C.W.)

19074 PERIOD OF THE 30.7-kev LEVEL OF Ta^{179}. N. N. Perrin and J. Valentin (Faculte des Sciences, Orsay, France). Phys. Letters, 8: 338-40(Mar. 1, 1964). (In French)

The E1 transitions from the 30.7-kev level ($^9/_2^-$) in ^{179}Ta were observed and a period of $(1.5 \pm 0.2) \times 10^{-6}$ sec was obtained. (R.E.U.)

19075 MIXED SYMMETRY STATE IN H^3 AND He^3. M. Fabre de la Ripelle (Faculte des Sciences, Orsay, France). Phys. Letters, 8: 340-2(Mar. 1, 1964). (In French)

The recently observed difference between the form factors of ^{3}H and ^{3}He is explained by the contribution of a function of mixed symmetry to the wave function of the three nucleons. The form factors are used to calculate the Coulombian energy of ^{3}He and the difference between the Coulombian energies of ^{3}H and ^{3}He. (D.C.W.)

19076 EXCITATION OF UNNATURAL-PARITY STATES IN (α,α') SCATTERINGS ON O^{16}, Ne^{20}, Mg^{24} AND Si^{28} AT 28.5 Mev. J. Kokame, K. Fukunaga, N. Inoue, and H. Nakamura (Kyoto Univ.). Phys. Letters, 8: 342-5 (Mar. 1, 1964).

The excitation of unnatural-parity states (2^-, 3^+, etc.) was investigated at E_α = 28.5 Mev on ^{16}O, ^{20}Ne, ^{24}Mg, and ^{28}Si at forward angles smaller than 90° (lab). Angular distributions of the inelastically scattered alpha particles are shown. Possible reaction mechanisms are discussed. (R.E.U.)

19077 LEVELS IN B^{10} ABOVE 5.16 Mev OBSERVED BY PROTON AND DEUTERON INELASTIC SCATTERING. B. H. Armitage (Atomic Energy Research Establishment, Harwell Berks, Eng.), and R. E. Meads. Phys. Letters, 8: 346-9(Mar. 1, 1964).

Energy levels in ^{10}B at 5.92, 6.03, 6.13, 6.55, and 7.00 Mev were observed by deuteron and proton inelastic scattering at 11 to 12 Mev. (R.E.U.)

19078 NEW LEVELS IN Sc^{49} FROM RADIATIVE CAPTURE OF PROTONS IN Ca^{48}. J. Dubois and S. Maripuu (Chalmers Univ. of Tech., Goteborg). Phys. Letters, 8: 349-51(Mar. 1, 1964).

Nuclear energy levels in the $f_{7/2}$-shell of ^{49}Sc were studied by (p,γ) reactions with ^{48}Ca. 66 resonances were found in the range E_p = 800 to 1400 kev. Evidence for low energy levels in ^{49}Sc at 2.22, 2.34, 3.10, 3.50, and 3.93 Mev was obtained from the gamma-ray single, coincidence, and sum coincidence spectra. (R.E.U.)

19079 ISOBARIC-ANALOGUE STATES IN Cu^{65}. L. L. Lee, Jr., A. Marinov, and J. P. Schiffer (Argonne National Lab., Ill.). Phys. Letters, 8: 352-4(Mar. 1, 1964).

The isobaric analogs of low-lying states in (d,p)-produced ^{65}Ni were observed in ^{65}Cu by adding a proton to ^{64}Ni. Proton widths of the analogous states were calculated from the neutron reduced widths determined in (d,p) experiments. Five resonances were observed in (p,n) and (p,p') reactions

on ^{64}Ni. It is concluded that isobaric analog states are spread very little, if at all, in the compound nucleus and that their energies are reproduced remarkably well. (R.E.U.)

19080 TRACES OF PRODUCTS OF COMPONENTS OF ANGULAR MOMENTUM OPERATORS. A. K. Bose (Université, Montreal). Phys. Letters, 9: 31-3(Mar. 15, 1964).

A direct method of evaluating traces of products of components of angular momentum operators for problems involving paramagnetic resonance and nuclear orientation is presented. (C.E.S.)

19081 QUASI-ELASTIC PROTON-DEUTERON COLLISIONS IN Li^6 AT 30 Mev. D. W. Devins, H. H. Forster, S. M. Bunch, and C. C. Kim (Univ. of Southern California, Los Angeles). Phys. Letters, 9: 35-6(Mar. 15, 1964).

The angular correlations between coincident protons and deuterons following the 30-Mev proton bombardment of ^{6}Li were investigated. The ^{6}Li(p,pd)^{4}He reaction gives strong support for the cluster structure $\alpha + d$ in ^{6}Li. (C.E.S.)

19082 SINGLE-PARTICLE PROTON STATES IN Cu^{63}. A. G. Blair (Los Alamos Scientific Lab., N. Mex.). Phys. Letters, 9: 37-40(Mar. 15, 1964). (LADC-6228)

Energy spectra and angular distributions for the ^{62}Ni(^{3}He,d)^{63}Cu reaction were obtained over the range from 13 to 39° at an incident energy of 22 Mev. The results reveal large single-particle contributions of the four proton states $^1/_2^-$, $^3/_2^-$, $^5/_2^-$, and $^7/_2^-$ in qualitative agreement with a unified-model calculation. The results disagree with the assignment of $^3/_2^-$ for the spin and parity of the fourth excited state but are consistent with the prediction of $^5/_2^-$. (C.E.S.)

19083 STUDY OF SOME EXCITED LEVELS OF Ca^{40} BY INELASTIC ELECTRON SCATTERING. M. Hors, H. Nguyen Ngoc, and J. Perez y Jorba (Ecole Normale Superieure, Orsay, France). Phys. Letters, 9: 40-4 (Mar. 15, 1964).

Inelastic electron scattering by ^{40}Ca was investigated at incident energies between 80 and 200 Mev and scattering angles of 60, 75, and 90°. Five excited levels were found. The results were analyzed in terms of multipole transition form factors assuming a smeared charge transition density for electric longitudinal transition. (C.E.S.)

19084 NEUTRON SPECTRA FROM π^- CAPTURE IN Cu, Sn, AND Pb. G. Campos Venuti, G. Fronterotta, and G. Matthiae (Istituto Superiore di Sanità, Rome). Phys. Letters, 9: 45-8(Mar. 15, 1964).

The energy spectra of neutrons emitted per pion capture in Cu, Sn, and Pb were investigated for an incident momentum of 150 Mev/c. Information about both the evaporation process at high excitation energy and the prompt emission of nucleons was obtained. (C.E.S.)

19085 STATISTICAL FLUCTUATIONS IN THE CROSS SECTIONS OF THE REACTIONS $Cl^{35}(p,\alpha)S^{32}$ AND $Cl^{37}(p,\alpha)S^{34}$. P. Von Brentano, J. Ernst, O. Haeusser, T. Mayer-Kuckuk, A. Richter, and W. Von Witsch (Max-Planck-Institut fur Kernphysik, Heidelberg). Phys. Letters, 9: 48-51(Mar. 15, 1964).

Measurements of the excitation function of the differential cross section for the reactions $^{35}Cl(p,\alpha)^{32}S$ and $^{37}Cl(p,\alpha)^{34}S$ at bombarding energies between 9.6 and 10.4 Mev in steps of 9 kev at several backward angles are reported. The marked fluctuations in the excitation functions of compound nucleus reactions in the region of overlapping levels of the compound nucleus are investigated. (C.E.S.)

19086 PHOTOEXCITATION OF ELECTRIC DIPOLE STATES IN Si^{28}. L. N. Bolen and J. M. Eisenberg (Univ. of Virginia, Charlottesville). Phys. Letters, 9: 52-3(Mar. 15, 1964).

The applicability of the particle-hole model to the light double closed-subshell nucleus ^{28}Si is examined. The (γ,n) reaction with ^{28}Si is discussed, and the positions and dipole strengths of the particle-hole excitations are calculated. (C.E.S.)

19087 "POLOLOGY" AND STRIPPING ANGULAR CORRELATIONS. D. Robson (Florida State Univ., Tallahassee). Phys. Letters, 9: 54-6(Mar. 15, 1964).

The application of polology to the angular correlation coefficients obtained from coincidence measurements of a $(d,p\gamma)$ reaction is considered. The central theme of the discussion is that by analytic continuation of the angular correlation functions to the poles of the plane wave Born approximation theory one is, in principle, measuring what could be called an experimental plane wave angular correlation function. (C.E.S.)

19088 DETERMINATION OF MULTIPOLE MIXTURE PARAMETERS FROM INTERNAL PAIR DATA. H. P. Kennedy and M. E. Rose (Univ. of Virginia, Charlottesville). Phys. Letters, 9: 57-9(Mar. 15, 1964).

Previous data from internal pair measurements are used to investigate the problem of determining the mixture ratio when two multipoles ML′ and EL contribute coherently to the measured (differential) pair formation coefficient. (C.E.S.)

19089 ON THE ABSORPTION OF NEGATIVE PIONS BY LIQUID HELIUM. G. T. Condo (Univ. of Tennessee, Knoxville and Oak Ridge National Lab., Tenn.). Phys. Letters, 9: 65-6(Mar. 15, 1964).

A de-excitation mechanism is proposed for the absorption of mesons (π^-) in liquid helium. It is shown that an alternate cascade scheme exists that is in accord with experiment and that does not require the absence of the molecular Stark effect. (C.E.S.)

19090 EVIDENCE FOR GIANT RESONANCE EXCITATION INDUCED BY THE CAPTURE OF MUONS IN O^{16}. J. Barlow (CERN, Geneva), J. C. Sens, P. J. Duke, and M. A. R. Kemp. Phys. Letters, 9: 84-8(Mar. 15, 1964).

A measurement of the total rate of capture of mesons (μ^-) in ^{16}O is reported. The result is in strong disagreement with the predictions based on an independent particle shell model. An alternative interpretation is discussed in terms of a collective excitation of the giant dipole resonance in ^{16}N. The interpretation appears to be in agreement with experiment. (C.E.S.)

19091 DECAY OF Tl^{210} TO STATES OF Pb^{210}. P. Weinzierl (Inst. for Physics, SGAE, Seibersdorf, Austria and Universitat, Vienna), E. Ujlaki, G. Preinreich, and G. Eder. Phys. Rev., 134: B257-66(Apr. 27, 1964).

The decay of ^{210}Tl sources was investigated by means of scintillation and semiconductor spectrometers. $\beta-\gamma$, $\gamma-\gamma$, and γ-sum-coincidence measurements were carried out. The β spectrum (from shell-model considerations presumably a first-forbidden transition) was decomposed into three components of 2.34 ± 0.10, 1.87 ± 0.10, and 1.32 ± 0.10 Mev. Twenty-four γ lines were found decomposing the NaI(Tl) scintillation spectrum; six of them showed measurable conversion lines in the semiconductor spectrometer, and their transition type could be inferred. Measurements of the delay of different parts of the γ spectrum with respect to the β rays revealed the existence of at least three states of measurable half-life, 1.7 ± 0.1, 1.1 ± 0.1, and 0.6 ± 0.1 nsec, the latter arising from the second excited state of 1.09 Mev. Calculations of the ^{210}Pb levels were carried out, using a zero-range approximation for the

interaction between the two extra neutrons and compared with the experimental level scheme. (auth)

19092 0^+ (T = 1) STATE AND THE RESIDUAL INTERACTION IN ODD-ODD DEFORMED NUCLEI. I. Kelson (Weizmann Inst. of Science, Rehovoth, Israel and Israel Atomic Energy Commission, Yavne). Phys. Rev., 134: B267-8(Apr. 27, 1964).

The 0^+(T = 1) low-lying states in the nuclei ^{18}F, ^{22}Na, and ^{26}Al show a regularity that is readily explained when each of these nuclei is described as an even-even core rotator with two odd nucleons coupled to it. It is shown that an acceptable short-range residual interaction between the two nucleons, together with the observed moments of inertia in this region, quantitatively reproduce that regularity. (auth)

19093 APPLICATION OF SELF-CONSISTENT FIELD METHODS TO ROTATIONAL MOTION IN sd SHELL NUCLEI. I. Kelson (Weizmann Inst. of Science, Rehovoth, Israel and Israel Atomic Energy Commission, Yavne) and C. A. Levinson. Phys. Rev., 134: B269-78(Apr. 27, 1964).

A self-consistent field calculation of the single-particle orbitals in the sd shell is presented. The calculation is based on a standard shell-model hamiltonian employing a single-particle spin-orbit force and two-body Yukawa interaction with a Rosenfeld exchange mixture. Using these orbitals the low-lying rotational spectra of the sd shell nuclei are computed. The variational formula of Skyrme and the cranking model yield moments of inertia that compare well with experimental data. The rotation-particle coupling interaction is diagonalized, and good fits to the nuclear rotational spectra are obtained. (auth)

19094 EIGENFUNCTIONS OF THE NUCLEAR PAIRING HAMILTONIAN. R. R. Chasman (Argonne National Lab., Ill.). Phys. Rev., 134: B279-84(Apr. 27, 1964).

An examination of the approximation of separability is made for the pairing hamiltonian $H = \sum_{k>0} \epsilon_k (a_k^\dagger a_k + a_{-k}^\dagger a_{-k}) - G \sum_{k>0,l>0} a_k^\dagger a_{-k}^\dagger a_{-l} a_l$; separability being defined as the decomposition of the amplitude of any configuration in the eigenfunctions of the pairing hamiltonian as a product of factors, one factor associated with each occupied level. This approximation is found to be inadequate for the single-particle energy-level spacings and values of G typically used in nuclear calculations. A somewhat less restrictive approximation is introduced that leads to considerably improved solutions of the pairing hamiltonian. The results of the approximate calculations are compared with available exact solutions, and the agreement is found to be extraordinarily good. (auth)

19095 DYNAMIC THEORY OF THE NUCLEAR COLLECTIVE MODEL. Michael Danos (National Bureau of Standards, Washington, D. C.) and Walter Greiner. Phys. Rev., 134: B284-96(Apr. 27, 1964).

The rotation-vibration model and the hydrodynamic dipole-oscillation model are unified. A coupling between the dipole oscillations and the quadrupole vibrations is introduced in the adiabatic approximation. The dipole oscillations act as a driving force for the quadrupole vibrations and stabilize the intrinsic nucleus in a nonaxially symmetric equilibrium shape. The higher dipole resonance splits into two peaks separated by about 1.5–2 Mev. On top of the several giant resonances occur bands due to rotations and vibrations of the intrinsic nucleus. The dipole operator is established in terms of the collective coordinates and the γ absorption cross section is derived. For the most important 1^- levels the relative dipole excitation is estimated. It is found that some of the dipole strength of the higher giant resonance states is shared with those states in which one surface vibration quantum is excited in addition to the giant resonance. (auth)

19096 DECAY OF Nd^{149} TO Pm^{149}. K. P. Gopinathan and M. C. Joshi (Tata Inst. of Fundamental Research, Bombay). Phys. Rev., 134: B297-307(Apr. 27, 1964).

The radiations from the decay of the 1.8-h ^{149}Nd were investigated using an intermediate-image beta spectrometer and scintillation coincidence spectrometers in conjunction with a 512-channel analyzer. Various gamma-gamma and beta-gamma coincidence measurements, not reported earlier, were made in order to establish the decay scheme with improved techniques. The beta spectrum showed four major components with end-point energies 1555 kev (6%), 1425 kev (38%), 1130 kev (26%), and 1025 kev (30%). The singles gamma spectrum showed the following gamma rays: 62, 80, 114, 158, 190, 210, 240, 272, 330, 375, 425, 540, and 650 kev. The 62, 80, 158, 272, and 330-kev gamma rays were not reported earlier. To explain the various gamma-gamma and beta-gamma coincidences a new decay scheme with levels in ^{149}Pm at 114, 210, 272, 352, 510, 538, 650, and 750 kev is proposed. The K-conversion coefficient of the 114-kev transition, which is not determined earlier, was measured and is found to be 0.83 ± 0.1. (auth)

19097 GROUND-STATE PROPERTIES AND LOW-LYING STATES OF THE N^{14} NUCLEUS. Nazakat Ullah (Brookhaven National Lab., Upton, N. Y.) and R. K. Nesbet. Phys. Rev., 134: B308-13(Apr. 27, 1964).

An approximate Hartree-Fock self-consistent-field calculation is carried out on the ^{14}N nucleus using the concept of symmetry and equivalence restrictions. The configuration interaction matrices belonging to a definite value of J, Π, T are constructed using the jj coupled configurations arising from $(1p)^{-2}$ shell. The approximate Hartree-Fock binding energy turns out to be 38.5 Mev too small, while it was only 13 Mev too small for the ^{16}O. This is attributed to an inadequate choice of the tensor interaction or to the omission of a two-body spin-orbit interaction. The static magnetic dipole moment is calculated to be 0.39 nuclear magneton and the rms radius is found to be 2.14 F The results are compared with the earlier intermediate coupling calculations. A number of low-lying even-parity states are calculated and compared with the experimental values. (auth)

19098 IMPROVED SUPERCONDUCTIVITY APPROXIMATION FOR THE PAIRING INTERACTION IN NUCLEI. Yukihisa Nogami (National Research Council, Ottawa and Battersea Coll. of Tech., London). Phys. Rev., 134: B313-21(Apr. 27, 1964).

The pairing interaction in nuclei is investigated by using a model hamiltonian $H - \lambda_1 N - \lambda_2 N^2$, where H is the original hamiltonian and N is the nucleon-number operator. The introduction of the term $\lambda_2 N^2$ enables one to suppress the effect of the nucleon-number fluctuation, which is inherent in the Bardeen-Cooper Schrieffer (BCS) approximation and is a main source of its inaccuracy. A prescription is given to determine the parameters λ_1 and λ_2. The method is first illustrated in the case where all levels are degenerate, and then applied to realistic cases with nondegenerate levels. Quadrupole and other interactions are not considered. Excited states with seniority zero as well as those with nonzero seniority are discussed. The results obtained by this method are compared with those of Kisslinger and Sorenson and of Kerman, Lawson, and Macfarlane. For the ground-state energy an excellent accuracy is attained easily. It is observed that the BCS states obtained by Kiss-

linger and Sorenson are much better approximations to eigenstates of our model hamiltonian rather than to those of their hamiltonian. A new light is shed on the problem as to why the projected and renormalized BCS states are very good approximations to the true eigenstates. (auth)

19099 STUDY OF THE $Pt^{189} \rightarrow Ir^{189} \rightarrow Os^{189}$ DECAY CHAIN. H. R. Lewis, Jr., R. A. Naumann, J. M. Prospero, and D. Thomas (Princeton Univ., N. J.). Phys. Rev., 134: B322-30(Apr. 26, 1964). (PUC-1963-113)

Permanent magnet electron spectrographs, a double-focusing electron spectrometer, and gamma-scintillation spectrometers were used to measure the energies and intensities of radiations that accompany the decay of ^{189}Pt. From these data, the conversion coefficients, multipolarities, and mixing ratios of a number of the transitions were determined. Some new transitions are reported, and a revised level scheme, incorporating all but one of the observed transitions, is proposed for ^{189}Ir. A half life of 10.87 ± 0.12 h was determined for ^{189}Pt. The gamma-scintillation spectrum obtained from a pure source of ^{189}Ir is reported. The half life of ^{189}Ir is 13.3 ± 0.1 days. (auth)

19100 ELECTROMAGNETIC STRUCTURE OF THE GIANT RESONANCE IN OXYGEN 16. F. H. Lewis, Jr. (Stanford Univ., Calif.). Phys. Rev., 134: B331-8(Apr. 27, 1964).

The transverse inelastic form factor for excitation of the giant resonance in oxygen-16 is calculated by means of the particle-hole theory of the giant resonance. The calculation is done in such a way that no free parameters are involved. In addition, calculations similar to those of Brown, Castillejo, and Evans were carried out, and the form factor was also calculated for the Goldhaber-Teller model. The results are compared with 180° electron-scattering experiments and with photoabsorption data. It is found that the particle-hole calculations predict the observed behavior for the squared form factor, and also the change in the shape of the giant resonance cross section which is seen experimentally as the momentum transfer $\underline{q}$ is varied. Neither of these effects is predicted by the Goldhaber-Teller model. Numerical results are presented for all of the different theoretical models, and it is found that the calculations involving no free parameters predict essentially the observed energy levels for the giant resonance and yield form factors that are consistent with all of the experiments considered. (auth)

19101 STUDIES OF ELECTROMAGNETIC TRANSITIONS IN N^{14} BY MEANS OF THE $C^{12}(He^3,p)N^{14}$ REACTION. E. K. Warburton, J. W. Olness, D. E. Alburger, D. J. Bredin, and L. F. Chase, Jr. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 134: B338-48(Apr. 27, 1964). (BNL-7543)

The electromagnetic decays of the ^{14}N states between 5 and 6.5 Mev were studied using the $^{12}C(^3He,p)^{14}N$ reaction. From investigations of the gamma spectra on and off the 3.0-Mev resonance for production of the ^{14}N 6.44-Mev level this state was found to decay to the ground, 3.95-, and 5.10-Mev levels of ^{14}N with branching ratios of (65 ± 3%), (21 ± 2)%, (14 ± 3)%, respectively. From a study of the internal pairs corresponding to the 6.21 → 2.31 transition, this transition was shown to be predominantly M1 so that the ^{14}N 6.21-Mev level has even parity. Similarly, it was confirmed that the ^{14}N 6.44 → 0 transition is predominantly E2. The angular distributions of the gamma rays from $^{12}C + {}^3He$ at $E_{^3He}$ = 2.75 Mev were measured. It was shown that the mixing parameter x (amplitude ratio of quadrupole to dipole radiation) for the 5.69 → 0 transition is $x = -0.12 \pm 0.03$. The branching ratios of the ^{14}N 5.10-, 5.69-, and 6.21-Mev levels to the ^{14}N ground state and 2.31-Mev first excited state were measured. The results are in satisfactory agreement with previous determinations. (auth)

19102 LIFETIMES OF THE N^{14} 5.83-Mev AND 6.44-Mev LEVELS. J. A. Becker and E. K. Warburton (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 134: B349-52(Apr. 27, 1964). (BNL-7433)

The lifetimes of the ^{14}N 5.83- and 6.44-Mev levels were studied by the Doppler shift attenuation method using the $^{12}C(^3He,p)^{14}N$ reaction to populate the levels. The shifts in energy of the 0.73-Mev 5.83 → 5.10 transition and the 1.33-Mev 6.44 → 5.10 transition were observed between two angles to the beam by recording gamma-ray spectra in coincidence with the ^{14}N 5.10 → 0 transition. From these measurements the mean lifetime of the ^{14}N 5.83-Mev level was found to be greater than 2.3×10^{-12} sec, while the mean lifetime of the ^{14}N 6.44-Mev level was found to be $(5.9 \pm 1.2) \times 10^{-13}$ sec. (auth)

19103 SCATTERING OF POLARIZED 3.25-Mev NEUTRONS BY MEDIUM WEIGHT NUCLEI. W. P. Bucher and D. W. Kent (Franklin Inst., Swarthmore, Penna.). Phys. Rev., 134: B361-4(Apr. 27, 1964).

The polarization produced in the 90° elastic scattering of 3.25-Mev neutrons from Fe, Ni, Co, Cu, Zr, and Mo was measured. The $D(d,n)^3He$ reaction was used as a source of partially polarized neutrons to determine the scattering asymmetry. The variation of the measured values with the atomic weight indicates a resonance structure similar to that observed by Clement et al. at 380 kev but with the polarization ranging from approximately −0.5 to +0.4. In addition, polarization measurements of neutrons scattered by C and W were performed. (auth)

19104 LOW LYING Sc^{44} LEVELS FROM THE $Sc^{45}(p,d)Sc^{44}$ REACTION. Edwin Kashy (Princeton Univ., N. J.). (PUC-1963-117)

The level structure of ^{44}Sc was investigated by measuring the energy spectrum of deuterons from the $^{45}Sc(p,d)^{44}Sc$ reaction at 17.5 Mev. The results show deuteron groups corresponding to 11 levels below 1.7 Mev at the following energies: 0, 0.266, 0.344, 0.646, 0.748, 0.952, 1.025, 1.165, 1.14, 1.51, and 1.66 Mev. The angular distributions of the deuterons were obtained and show that the 6 lowest lying levels observed correspond to the pickup of an $f_{\frac{7}{2}}$ neutron from ^{45}Sc. A comparison is made with recent theoretical predictions. (auth)

19105 RADIATIVE MUON CAPTURE IN HYDROGEN. Geoffrey I. Opat (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 134: B428-35(Apr. 27, 1964).

It is shown that Γ_{rad}, the rate (in sec^{-1}) of the radiative muon capture reaction $\mu^- + p \rightarrow \gamma + \nu + n$, is very different in the two eigenstates of total $[\mu^- p]$ spin (hyperfine effect in radiative muon capture). It is further shown that, in each of these two eigenstates, Γ_{rad} depends sensitively on the magnitude of the pseudoscalar form factor. In particular for $g_P^{(\mu)} = 8g_A^{(\mu)}$ (pseudoscalar form factor dominated by a single pion pole term) the ratio, $R = \Gamma_{rad}/\Gamma_{nonrad}$, of radiative to nonradiative muon capture rates is given by: $R_{sing} = 4.96 \times 10^{-3}/634 = 0.079 \times 10^{-4}$ (spin-singlet $[\mu p]$ atom); $R_{trip} = 9.00 \times 10^{-2}/13.3 = 69 \times 10^{-4}$ (spin-triplet $[\mu p]$ atom); $R_{mixt} = 6.87 \times 10^{-2}/168 = 4.1 \times 10^{-4}$ (statistical mixture of spin-singlet and spin-triplet $[\mu p]$ atoms); $R_{molec} = 3.07 \times 10^{-2}/560 = 0.55 \times 10^{-4}$ (spin-double ortho $[p\mu p]$ molecule). If, on the other hand, $g_P^{(\mu)} = 16g_A^{(\mu)}$ (with the additional contribution to the pseudoscalar form factor taken to be effectively independent of momentum transfer for $|q^2| \lesssim m_\pi^2$), the ratios R become: $R_{sing} = 14.6 \times 10^{-3}/503 = 0.29 \times 10^{-4}$; $R_{trip} = 11.8 \times 10^{-2}/37.0 = 32 \times 10^{-4}$; $R_{mixt} = 9.19 \times 10^{-2}/$

$154 = 6.0 \times 10^{-4}$; $R_{molec} = 4.72 \times 10^{-2}/452 = 1.04 \times 10^{-4}$, so that the sensitivity mentioned is exhibited. (auth)

19106 LIFETIME AND HFS OF THE (5s5p) $^1P_1$ STATE OF CADMIUM. Allen Lurio and Robert Novick (Columbia Univ., New York). Phys. Rev., 134: A608-14(May 4, 1964).

The lifetime and hfs of the (5s5p) $^1P_1$ state of cadmium were measured by the level crossing technique. Coherence narrowing of the zero-field level crossing (Hanle effect) signal was observed and found to be in agreement with Barrats theory. The lifetime obtained from two independent experiments is $1.66 \pm 0.05 \times 10^{-9}$ sec. This value is considerably smaller than earlier values. The ratio of this lifetime to the (5s5p) $^3P_1$ state lifetime obtained by Byron et al. is $6.95 \pm 0.30 \times 10^{-4}$—in good agreement with the results of Filippov and Kuhn. The dipole interaction constant $A(^1P_1)$ obtained for ^{111}Cd is $|A(^1P_1)| = 186 \pm 4$ Mc. This result is compared to that obtained by Heydenburg. Using the present lifetime measurement and the known hfs intervals for the $^3P_2$ and $^3P_1$ states the theoretical value of this constant is found to be $A(^1P_1) = -152 \pm 25$ Mc. The single electron hfs constants for the (5s5p) configuration are tabulated. (auth)

19107 INTERACTION OF MEDIUM-ENERGY NUCLEONS WITH COMPLEX NUCLEI. Louis Rosen (Los Alamos Scientific Lab., N. Mex.). Phys. Today, 16: 21-4; 26-8; 30-1(Nov. 1963). (LADC-5838)

Nuclear structure study from 1- to 50-Mev nucleon interactions with complex nuclei is discussed. Reaction mechanisms are discussed. (R.E.U.)

19108 THE REACTION ^{20}Ne(p,γ)^{21}Na. C. Van der Leun and W. L. Mouton (Rijksuniversiteit, Utrecht). Physica, 30: 333-40(Feb. 1964).

The decay scheme, the width, and the strength of the E_p = 1169, 1955, and 2138 kev resonances in the reaction ^{20}Ne(p,γ)^{21}Na are reported. The spins of the first two resonances are $J^\pi = 5/2^+$ and $5/2$, respectively. Coincidence and angular correlation measurements at the E_p = 1955 kev resonance yield the excitation energy and spin of the ^{21}Na first excited state: $E_x = 338 \pm 3$ kev and $J^\pi = 5/2^+$. The mixing ratio of the 0.34-Mev γ ray de-exciting this level is $x = 0.05 \pm 0.05$. Measurements of the resonance- and γ-ray energies yield the reaction Q value, $Q = 2424 \pm 10$ kev. The corresponding ^{21}Na mass excess is -2177 ± 10 kev. (auth)

19109 LARGE-ANGLE MULTIPLE SCATTERING OF μ-MESONS IN LEAD. M. K. Sundaresan and S. D. M. Ahuja (Panjab Univ., Chandigarh, India). Proc. Natl. Inst. Sci. India, Pt. A, 28: 230-7(Mar. 26, 1962).

It is shown that the corrected theory of multiple scattering and the modifications thus introduced in the theory of multiple scattering, when applied to the scattering of 1-Bev μ mesons in lead at angles between 0 and 7 degrees, do not show the existence of any anomalous interaction between μ mesons and nuclei, apart from the purely electromagnetic interaction. (auth)

19110 INELASTIC COLLISIONS OF 6-Bev PROTONS. V. Y. Rajopadhye (Univ. of Poona, India). Proc. Natl. Inst. Sci. India, Pt. A, 28: 238-43(Mar. 26, 1962).

By studying the angular distribution of the shower particles, the energy of the primary particles is estimated with emulsion plate techniques on the assumption of a nucleon-nucleon collision. It is concluded that the meson production on an average occurs as if the incident proton suffered a collision with a particle within the nucleus, of mass number greater than 1.08 proton mass units. (auth)

19111 Λ-PARTICLE BINDING IN NUCLEAR MATTER. P. C. Sood (Panjab Univ., Chandigarh, India). Proc. Natl. Inst. Sci. India, Pt. A, 28: 269-71(Mar. 26, 1962).

Using the separation method, a calculation has been made of the depth of the Λ-nucleon potential in nuclear matter. The result, viz. $E_\Lambda = 22.56$ Mev, is quite close to the empirical value 21.7 Mev derived from the systematics of hypernuclei. (auth)

19112 DETERMINATION OF THE COHERENT-SCATTERING CROSS SECTION FOR NEUTRONS ON GALLIUM. Yu. Ya. Konakhovich and V. A. Somenkov (Kurchatov Inst. of Nuclear Energy, Academy of Sciences, USSR). Soviet Phys.-Cryst. (English Transl.), 8: 626-8 (Mar.-Apr. 1964).

The thermal neutron coherent scattering cross section for gallium was determined by means of a crystal diffractometer and polycrystalline gallium arsenide. (C.E.S.)

19113 NEW SHORT-PERIOD RUTHENIUM AND TELLURIUM ISOMERS. A. G. Demin and I. M. Rozman. Zh. Eksperim. i Teor. Fiz., 45: 2067(Dec. 1963). (In Russian)

Irradiation of thick chemically pure elements by 22-Mev α particles and 11-Mev deuterons produced new short-period Ru and Te isomers. $T_{1/2} = 1.84$ μsec was assigned to Ru and $T_{1/2} = 104$ μsec to Te. It was postulated that the mass numbers of the new Ru and Te isomers are 97 and 117 (or 115), respectively. (R.V.J.)

19114 FORMATION OF FAST RESIDUAL NUCLEI. V. I. Bogatin, O. V. Lozhkin, and Yu. P. Yakovlev. Zh. Eksperim. i Teor. Fiz., 45: 2072-3(Dec. 1963). (In Russian)

A hypothesis of intranuclear reactions describing the fragmentation in heavy nuclei was studied using the ^{9}Be(p,2p)^{8}Li reaction with 660-Mev protons. The reaction permits the recording of residual ^{8}Li nuclei and studying the distribution of residual nuclei found at the same energy level. (R.V.J.)

19115 POLARIZATION OF THE γ-RAYS FROM THE $Si^{30}(p,\gamma)P^{31}$. P. M. Tutakin (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 46: 10-17(Jan. 1964). (In Russian)

The plane polarization of γ rays from the reaction ^{30}Si(p,γ)^{31}P is measured with photographic plates impregnated with heavy water for resonances at E_p = 1514, 3308, and 3435 kev. The spin and parity of the resonance level in the ^{31}P nucleus are $5/2^+$. The spins of the 10.492 (E_p = 3308 kev) and 10.615-Mev (E_p = 3435 kev) resonance level may be respectively $3/2$ and $\geq 5/2$. (auth)

19116 CROSS SECTIONS FOR RADIATIVE CAPTURE OF NEUTRONS WITH ENERGIES UP TO 50 kev BY La^{139}, Pr^{141}, Ta^{181} AND Au^{197} NUCLEI. V. A. Konks, Yu. P. Popov, and F. L. Shapiro (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 46: 80-8(Jan. 1964). (In Russian)

Cross section curves for radiative capture of neutrons and data on the resonance capture integrals obtained with a lead neutron slowing down time spectrometer are presented. The values of the force functions for p-neutrons (S_1) and of the quantities $S_\gamma = \Gamma_\gamma/\overline{D}_J\,(2J+1)$ are determined on the basis of an analysis of the energy variation of the capture cross sections. For lanthanum the values are $S_1 = (2.0 \pm 0.9) \times 10^{-4}$, $S_\gamma = (0.20 \pm 0.02) \times 10^{-4}$; for praseodymium $S_1 = (1.1) \times 10^{-4}$, $S_\gamma = (0.60 \pm 0.07) \times 10^{-4}$; for tantalum $S_1 \sim 0.2 \times 10^{-4}$ and for gold $S_1 \sim 0.3 \times 10^{-4}$. (auth)

19117 RESONANCE ABSORPTION OF γ QUANTA IN MAGNESIUM STANNIDE (Mg_2Sn). THE 23.8-kev AB-

SORPTION LINE WITH A NATURAL WIDTH. V. A. Brukhanov, N. N. Delyagin, and R. N. Kuzmin (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 46: 137-41(Jan. 1964). (In Russian)

Resonance absorption of 23.8-kev γ quanta by ^{119}Sn nuclei in the Mg_2Sn compound is investigated at temperatures between 77 and 290°K. The probability for γ-quantum absorption without recoil is 0.77 at 77°K and 0.28 at room temperature. The absorption line width in Mg_2Sn is 0.32 ± 0.02 mm/sec which is in good agreement with the value corresponding to the lifetime of the 23.8-kev excited state. The results are interpreted on the basis of data on the structure and properties of the chemical bond in Mg_2Sn. (auth)

19118 BOUNDARY ENERGY OF A FERMI GAS IN A POTENTIAL WELL. S. A. Gurvits, A. A. Migdal, and A. M. Polyakov (Inst. of Physics and Tech., Moscow). Zh. Eksperim. i Teor. Fiz., 46: 213-17(Jan. 1964). (In Russian)

The relation between the Fermi energy and number of particles is extended to the case of a gas in a potential well with a diffuse edge. The results are employed for calculating the boundary Fermi energy of neutrons in heavy nuclei with an accuracy ~1 Mev. The mean distance between the levels and the nuclear surface energy are calculated for the last elements of the Mendeleyev table. The calculations are performed for the optical model potential. (auth)

19119 REGGE POLES IN THE PROBLEM OF THE QUASICLASSICAL POTENTIAL WELL AT ENERGIES BELOW THE WELL BOTTOM. I. A. Fomin (Moscow Inst. of Physics and Tech.). Zh. Eksperim. i Teor. Fiz., 46: 270-2(Jan. 1964). (In Russian)

It is shown that for energies below the bottom of the well, poles that are arranged on the real axis in pairs can collide and enter the complex plane. The positions of the collision points are found, and a formula for the behavior of the poles for $E \to -\infty$ is derived. (auth)

19120 INVESTIGATION OF THE $Li^7(p,\alpha)He^4$ REACTION INDUCED BY 0.5-2 Mev POLARIZED PROTONS. Yu. P. Antufev, T. Bunduk, A. Fikri, F. Machali, and P. V. Sorokin. Zh. Eksperim. i Teor. Fiz., 46: 409-14(Feb. 1964). (In Russian)

The sensitivity of the $^7Li(p,\alpha)^4He$ reaction to proton polarization is measured in the 0.5-2 Mev energy range. Polarized protons were obtained by $^{12}C(p,p)$ elastic scattering. At low energies and an angle of 45° the sensitivity of the $^7Li(p,\alpha)^4He$ reaction does not exceed 10%; with increasing proton energy the sensitivity gradually increases and reaches 60% at 2 Mev. (auth)

19121 THE ENERGY SPECTRA AND ANGULAR DISTRIBUTION OF Li^8 FRAGMENTS PRODUCED IN THE INTERACTION BETWEEN 660 Mev PROTONS AND ALUMINIUM NUCLEI. V. I. Bogatin, O. V. Lozhkin, N. A. Perfilov, and Yu. P. Yakovlev. Zh. Eksperim. i Teor. Fiz., 46: 431-4(Feb. 1964). (In Russian)

The angular distribution and energy spectra of ^8Li fragments produced in the disintegration of aluminum nuclei induced by 600-Mev protons are studied experimentally. The absence of the ^8B isobar among the disintegration products and the identity of the ^8Li spectra at angles of 90 and 47° with the respective spectra for disintegrated carbon nuclei are discussed from the viewpoint of the model of intranuclear reactions on nucleon associations localized on the surface of the nucleus. The angular distribution of ^8Li fragments from aluminum calculated on the basis of this model is found to satisfactorily agree with experimental data. (auth)

19122 ORIENTED Tb^{160} NUCLEI IN METALLIC TERBIUM. V. P. Parfenova, V. N. Anishchenko, and V. S. Shpinel (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 46: 492-6(Feb. 1964). (In Russian)

Terbium-160 nuclei were polarized in a polycrystalline sample of metallic terbium that is ferromagnetic below 218°K. The sample was cooled to 0.03-0.04°K by adiabatic demagnetization. Cobalt-60 was employed as the thermometer. Anisotropy of the angular distribution of the 298-kev γ rays was measured. The hyperfine splitting constant was determined, A = 0.054 ± 0.007°K. (auth)

19123 EFFECT OF ANHARMONISM ON THE MÖSSBAUER LINE INTENSITY. M. A. Krivoglaz (Inst. of Metal Physics, Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 46: 637-48(Feb. 1964). (In Russian)

The effect of anharmonism on the intensity of Mössbauer lines in the presence of local oscillations is considered. Even the taking into account of a weak anharmonism qualitatively changes the time dependence of the correlation function and results in the products of Bessel functions vanishing from the expression for the intensity. The corresponding intensity difference is found to be distributed around the Mössbauer line in a narrow band with a width $\sim\Gamma_\kappa$ where Γ_κ is the level width of the local oscillation. The effect of anharmonism on the Debye-Waller factor is discussed. As a result of taking into account anharmonism, the dependence of the Mössbauer line intensity on temperature and wave vector is found to change and, in particular, an anisotropy of the Mössbauer effect in cubic crystals appears. Analogous effects may occur in solid solutions in the harmonic approximation. The effect of anharmonism on the single-phonon spectrum is considered. (auth)

19124 SCATTERING OF POLARIZED γ QUANTA IN THE FIELD OF A NUCLEUS ACCOMPANIED BY ELECTRON-POSITRON PAIR PRODUCTION. I. M. Nadzhafov, N. A. Tenyakova, and A. I. Mukhtarov (Azerbaijan State Univ.). Zh. Eksperim. i Teor. Fiz., 46: 769-75(Feb. 1964). (In Russian)

The angular and energy distribution of electron-positron pairs and of the scattered γ quanta in the $\gamma + (Ze) \to (Ze)' + \gamma' + e^+ + e^-$ reaction is investigated by taking into account the polarizations of all the particles. The degrees of polarization of the pair and scattered γ quantum are determined. (auth)

19125 PHOTONUCLEAR REACTIONS. Bibliographical Series No. 10. (International Atomic Energy Agency, Vienna). 1964. 412p. STI/PUB/21/10. $8.00; Sch 168; 48 s.stag; F. fr. 32; DM 28 (IAEA).

References (2254) are included from domestic and foreign literature (January 1948 to August 1963) on experimental and theoretical studies of photodisintegration, electrodisintegration, photon absorption and scattering, photofission and meson photoproduction. Author and subject indexes are included. (D.C.W.)

Plasma Physics and Thermonuclear Processes

19126 (AD-414878) EXPERIMENTAL DETERMINATION OF THE ELECTRICAL CONDUCTIVITY OF NOBLE GAS-ALKALI METAL PLASMAS (thesis). Frank C. Halstead and Eugene L. Larson (Massachusetts Inst. of Tech., Cambridge). Aug. 19, 1963. 49p.

The electrical conductivity of an Ar-K plasma was successfully measured. The experimental results indicate that the temperature of the electrons is greater than the temperature of the plasma. It is shown that the two-

temperature theory is correct as a first estimate of the conductivity of the plasma. An accurate method for measuring the electron temperature was developed; the measurements verify the presence of two distinct temperatures. (auth)

19127 (CLM-R35) THE MICROWAVE EMISSIVITY OF A TURBULENT PLASMA WITH NON-PARALLEL ORIENTATION OF THE TURBULENCE ELEMENTS. D. J. H. Wort (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Abingdon, Berks, England). Feb. 1964. 10p.

Previous calculations on the microwave emissivity of a turbulent plasma are extended by considering the effect of non-parallel alignments of the turbulence elements. It is found that random orientation can alter the emissivity of the parallel turbulence by a factor of 0.27 to 1.70. But for the more realistic helical representation of a turbulent diffuse plasma, the ratio of helical to parallel emissivity is closer to 1 (0.52–1.12). (auth)

19128 (IPPJ-18) DAMPING OF PHONONS IN AN ELECTRON-ION GAS. Toshiyuki Nishiyama (Nagoya, Japan. Univ. Inst. of Plasma Physics). Dec. 1963. 13p.

The relaxation time and phonon mean free path for an electron-ion gas (a quantum plasma) were from the expression for the angle of dielectric loss. The familiar formula for the dielectric constant given by Nozières was extended to include the life-time effect of electronic levels. In this way a quantum mechanical version of Pippard's semi-classical theory for the phonon mean free path was derived. The result can be applied to liquid metals and classical plasmas. High electron temperatures were also considered, and the polarizability in the presence of a static magnetic field was obtained. (auth)

19129 (IPPJ-19) RF CURRENT COMPONENT IN THE RESONANCE PROBE. J. Uramoto, J. Fujita, H. Ikegami, and K. Takayama (Nagoya, Japan. Univ. Inst. of Plasma Physics). Dec. 1963. 16p.

The d-c and r-f components of the current to a resonance probe in a quiescent, low-density plasma produced by back-diffusion mercury vapor discharges were measured separately, but simultaneously, to determine the relation of the resonance, r-f, and plasma frequency probes. The results indicate that the resonance in the d-c and r-f currents may not be at the electron plasma frequency. (D.C.W.)

19130 (NP-13610) NOVYE REZUL'TATY PO TURBULENTNOMU NAGREVU PLASMY. (New Results in Turbulence Heating of Plasma). M. V. Babykin, P. P. Gavrin, E. K. Zavoiskii, L. I. Rudakov, V. A. Skoryupin, and G. V. Sholin (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoĭ Energii). 1963. 45p.

An analysis was made of the turbulent heating of plasma and the theory of the process. At particle densities from 10^{12} to 10^{13} cm^{-3} the energy density of plasma electrons is 10^{15} ev · cm^{-3}, which is equivalent to 20% of $H^2/8\pi$. Under certain conditions the electron heating is accompanied by heating ions to ~150 ev. Containment times for 100-ev ions is ~130 μsec and 500-ev electrons were ~130 and ~60 μsec. The plasma containment in the trap was quite stable. Ion cyclotron waves and plasma oscillations were observed. (tr-auth)

19131 (NP-13613) VLIYANIE POPERECHNOGO MAGNITNOGO POLYA NA TOROIDAL'NYI RAZRYAD V SIL'NOM PRODOL'NOM MAGNITNOM POLE. (Influence of a Transversal Magnetic Field upon a Toroidal Discharge in a Strong Longitudinal Magnetic Field). B. M. Grigorovich and V. S. Mukhovatov (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoĭ Energii). 1963. 24p.

Effects of a transverse magnetic field on toroidal discharge in a strong longitudinal magnetic field were investigated. It was revealed that with a certain pinch shift induced by a force $1/c[IB_1]$, the electric discharge fluctuation have minimum amplitudes and the plasma mean conductivity reaches a maximum. Effects of the magnetic field transverse component are explained using the concept of plasma cylinder equilibrium in a conducting container. (tr-auth)

19132 (NP-13699) METOD ISSLEDOVANIYA PLAZMY PUCHKOM BYSTRYKH CHASTITS. (Method of Investigating a Plasma with a Fast-Particle Beam). L. I. Krupnik and N. G. Shulika (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1963. 9p.

An attempt was made to measure hydrogen plasma parameters by probing with beams of fast hydrogen atoms and ions. In magnetically confined plasma probing is done with a neutral beam. The beam of fast hydrogen atoms ($H_\perp^0$) cross the plasma. Assuming that ionization is high it is possible to isolate the resonance charge $H_\perp^0 + H_\perp^+ \rightleftharpoons H_\parallel^+ + H_\perp^0$ resulting in the beam. The cross section (σ) for the process increases as the energy of the interacting particles is decreased; with E ~ 3.8 kev it reaches ~10^{-15} cm^2. Such weakening of the neutral beam is described by $\Delta N^0 = N^0 (1-e^{-\sigma nL})$, where n is the number of particles per cm^3 of plasma, L is the path length of the probing beam, N^0 and ΔN^0 are intensities of the primary and resulting beams. By measuring ΔN^0, N^0, σ, and L it is possible to calculate plasma density. In the absence of magnetic field, probing is done with mixed neutral and charged particles. The charged particles (protons) feel the neutral plasma components (H_1^0 and H_2^0). In such case the transformation is $H_1^+ \rightarrow H_1^0$, with cross sections reaching ~10^{-15} cm^2. Thus using charged and neutral particles it is possible to determine the density and ionization of charged and neutral plasma components. (R.V.J.)

19133 (NP-13772) ACCELERATION OF A ROTATING PLASMA. Rijnhuizen Report No. 63-13. E. Minardi (Stichting Voor Fundamenteel Onderzoek der Materie. Instituut Voor Plasma-Fysica, Jutphaas, Netherlands). Oct. 1963. 29p.

The motion of an axisymmetric, low-density, collisionless plasma rotating in crossed external E_r and B_z fields and longitudinally accelerated by a B_r field is analyzed by the macroscopic equations of motion and by the adiabatic approximation. Charge separation related to a radial drift of the ions appears. The resulting self-consistent electric field in first order is calculated. The electric field in zero order is determined by the self-consistent electric field given at the entrance of the accelerator channel. When the electrical susceptibility is high, it varies along the z axis, proportionally to B. This zero order electric field describes the shielding effect and the sheath formation, the calculation of which is then reduced from the axial to the cylindrical geometry. The d-c generator delivers energy to the plasma through the radial current supported by the drifting ions. The power of the generator is given as function of the longitudinal ejection velocity and of the plasma density. The possibility of obtaining, in this way, a jet of high velocity plasma is indicated. (auth)

19134 (NP-13776) FEASIBILITY OF BEAM-PLASMA AMPLIFICATION OF MILLIMETER WAVES. Quarterly Progress Report No. 4, November 15, 1962–February 15,

1963. Paul Chorney (Microwave Associates, Inc., Burlington, Mass.). Contract NObsr-81206. 33p.

Beam-plasma-amplifier experiments are described which are being performed with the metal-ceramic X-band study vehicle. Net gains of 30 db and greater are obtained using a xenon plasma; experiments using argon, nitrogen, and vacuum are also described. The life test performed on a hollow cathode gun has concluded, the total useful life of the gun being about 400 hours. More plasma density measurements are performed on a mercury P.I.G. discharge with a Langmuir probe. The results show that plasma frequencies near 70 Gc are obtained and that the radial density profile of the plasma is very uniform over a large center portion. The observations of anomalous diffusion in a magnetic field is also pointed out The progress in the design of the 70 Gc beam-plasma-amplifier study vehicle is described. Results of cavity cold tests and tests on mica vacuum windows are outlined. A gun model is constructed which is designed to deliver an 0.008 in. diameter electron beam. (auth)

19135 (NP-13777) DYNAMICS OF IONIZING SHOCK WAVES. I. TRANSVERSE SHOCKS. Plasma Research Laboratory Report No. 7. C. K. Chu (Columbia Univ., New York. School of Engineering and Applied Science). Jan. 1964. Contract AF49(638)-1254. 42p.

A simplified model is presented of ionizing shock waves in a magnetic field which is tangential to the shock front. In this model, the gas ahead of the shock is assumed to be a perfect nonconductor and that behind a perfect conductor, and the energy required in the ionization process is ignored. Differences that would have arisen in the results if the assumptions were less simplified are discussed. The jump conditions across the shock are discussed, and it is shown that the shock structure relationships are indeed jump conditions. Some numerical results are presented for the piston problem. (D.L.C.)

19136 (NP-13781) TSIKLOTRONNAYA NEUSTOICHVOST' ANIZOTROPNOI PLAZMY. (Cyclotronic Instability of an Anisotropic Plasma). V. I. Pistunovich (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii and Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). [1963]. 87p.

Correlations were made of theoretical and experimental data on cyclotron instability in infinite plasma. The problem of a plasma in which ions rotate in one direction around a general axis of cold electrons at various radii was analyzed. The relation of stability in such a plasma to the driving longitudinal oscillations induced by charge separation was investigated. It is shown that the development of cyclotron instability with evenly distributed ions in an infinite space without separate axial rotation is related to anisotropic plasma in the velocity space. Conditions conducive to cyclotron instability were found, and increments of instability for the case in which the ion distribution function has a δ-function shape (similar to ion distribution in Ogra) were estimated. Cyclotron instability for the general case of a homogeneous anisotropic Maxwell plasma were also analyzed. Minimum anisotropic magnitudes, $\tau = (T_{\perp}i/T_{\parallel}i)$, for initial plasma instability were determined, and effects of electron temperature on the development of cyclotron instability were estimated. Experiments carried out with Ogra are described, and postulations are made on the effects of cyclotron instability on hot plasma accumulations in magnetic traps. (R.V.J.)

19137 (SIT-121) X-RAY EMISSION IN A DC-BIASED CESIUM PLASMA "THETA-PINCH" MACHINE. W. Pak, K. C. Rogers, H. Huber, P. Stern, and G. Schmidt (Stevens Inst. of Tech., Hoboken, N. J.). [1963]. Contract AT(30-1)-2813. 16p.

The conditions under which hard (~100 kev) x-rays are emitted from a highly-ionized, steady-state magnetoplasma column that is suddenly subjected to a rapidly oscillating theta-pinch magnetic field were studied. Plasmas with a density of up to 1.5×10^{11} cm^{-3} were produced by surface ionization at a hot plate. The most notable result was that unless the net field passed through zero, no x-ray emission was observed. (D.C.W.)

19138 (CEA-tr-A-1464) CONSTRUCTION D'UN RADIOMÈTRE POUR LA MESURE DU RAYONNEMENT DE MICRO-ONDES DE PLASMAS STATIONNAIRES. (Construction of a Radiometer for the Measurement of the Microwave Radiation of Stationary Plasmas). Friedrich Klan (Max-Planck-Institut für Physik und Astrophysik, Munich). Translated into French. 1961. 108p. (Includes original, 57p.).

A radiometer for 3-cm waves with mechanical signal modulation was constructed for measurements on low-temperature, stationary plasmas. The sensitivity limit of the device was also calculated in good agreement with experiment. The theory used for the calculation is presented, and the radiometer is described. (D.C.W.)

19139 (FTD-TT-61-277) NONLINEAR EFFECTS IN A MAGNETOACTIVE PLASMA. V. V. Zheleznyakov (Zheleznyakov). Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 1: No. 5-6, 29-33(1958). 11p.

The frequency dependence of cross modulation (Luxemburg-Gorkovskiy effect) is discussed. It is shown that in a homogeneous magnetoactive plasma, cross modulation increases as the frequency of the perturbing wave approaches values at which the absorption index of this wave rises abruptly. These values, generally, do not coincide with the gyrofrequency. The conclusion concerning the "resonance" of cross modulation at the gyrofrequency in a homogeneous plasma, previously drawn in the theory of the Luxemburg-Gorkovskiy effect, was due to not taking into account the nature of the polarization of the perturbing wave in the presence of a magnetic field. (auth)

19140 (ORNL-tr-58) THE USE OF AN OPTICAL QUANTUM GENERATOR FOR DIAGNOSIS OF A PLASMA. A. N. Zaidel', G. M. Malishev, and G. V. Ostrovskaya. Translated by Joseph Lewin (Oak Ridge National Lab., Tenn.), from "Plasma Diagnostics," Gosatomizdat, 1963. 8p.

Expressions were obtained for the maximum and minimum electron densities that can be determined by scattering light from a ruby laser on the free plasma electrons. Calculations were made for laser radiation energies of 0.5 to 500 joules (intensities of 10^3 to 10^6 w). The results show that the region of electron densities and temperatures for which the technique is applicable broadens with increasing laser energy and intensities. (D.C.W.)

19141 LONGITUDINAL OSCILLATIONS IN THE PLASMA. Gr. Ghika (Inst. of Atomic Physics, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Fiz., 14: 819-55(1963). (In Rumanian)

Some of the classical plasma problems are reviewed, considering cases involving low particle density and high temperature, under which the Maxwell-Boltzmann equilibrium distribution laws may be applied. After presenting a simplified plasma theory based on Euler's hydrodynamic flow equations and on Maxwell's equation, a method applying Boltzmann's equation is developed without taking into consideration the term due to collisions; it is also assumed that there are no external fields and the equation may be

presented in a linear form. The solution is based on the derivations obtained by N. G. Van Kampen (Physica 21: 949(1955)) and L. D. Landau (J. Phys. USSR 10: 25(1946)). The system based on Boltzmann's equation presents perfect reversibility, conserving the total entropy, due to the fact that collisions were neglected. Statistical mechanics considerations require starting from the Liouville equation for defining the density. In some of the supplementary applications, the solution of A. Vlasov's equation (J. Phys. USSR 9: 25, 130(1945)) may be considered as the zero-order approximation of the exact kinetic equation. (Review article, 36 references). (TTT)

19142 EXPERIMENTS ON TURBULENT MIXING IN A PARTIALLY IONIZED GAS. Jerry Grey and Paul F. Jacobs (Princeton Univ., N. J.). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 433-8(Mar. 1964).

Experimental studies were performed on the turbulent mixing of a partially ionized primary jet with a cool secondary stream. The round primary jet was partially ionized argon, and the annular secondary stream was helium at ambient temperature. Both flows were at atmospheric pressure and were subsonic. Local physical measurements of total gas enthalpy, dynamic pressure, and secondary gas concentration were obtained using a calorimetric probe technique. No electric or magnetic fields were applied, so that the plasma was neutral, and prior analytical estimates had indicated that the existence of equilibrium between the electrons and the heavy particles could be assumed. These conditions then allowed the calculation of temperature, velocity, and specie concentration profiles at the various axial positions. Peak temperatures were found to be 23,800°R, corresponding to about 25% singly ionized argon concentration. The existence of a potential core was verified, and it was found that the decay of the plasma jet was extremely rapid. It was also found that mass spreads more rapidly than energy, which in turn spreads more rapidly than momentum. The boundaries defining the spreading of these quantities were nonconical, as compared with the conical result at low temperature. The effects of ionization, as distinct from those due purely to high temperature, appeared to be negligible except for the onset of radiation, which can become a significant energy transfer mechanism above about 21,000°R. (auth)

19143 COMMENT ON "A CLASS OF LINEAR MAGNETOHYDRODYNAMIC FLOWS." Thomas P. Anderson (Northwestern Univ., Evanston, Ill.). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 588-90(Mar. 1964).

Critical comments are presented, concerning a paper whose subject was the manner in which the nonlinear terms in the governing equations for incompressible MHD flow problems may be identically satisfied. (T.F.H.)

19144 CYCLOTRON RADIATION OF AN Hg PLASMA GENERATED BY AN ELECTRON BEAM. G. Bekefi and E. B. Hooper, Jr. (Massachusetts Inst. of Tech., Cambridge). Appl. Phys. Letters, 4: 135-6(Apr. 15, 1964).

The microwave radiation from a plasma generated by an electron beam fired into an unionized low-pressure mercury vapor in a uniform magnetic field was measured. The emission is shown to depend on collective motions of the particles. A microwave radiometric method was used. (R.E.U.)

19145 OBSERVATION OF SPATIALLY GROWING WAVES AT THE CYCLOTRON HARMONICS IN AN ELECTRON-BEAM-GENERATED He PLASMA. S. Gruber, W. D. McBee, and L. T. Shepherd (Sperry Rand Research Center, Sudbury, Mass.). Appl. Phys. Letters, 4: 137-8 (Apr. 15, 1964).

Radio-frequency probe measurements of the radiation intensity peaks near the harmonics of the electron cyclotron frequency in a beam-generated plasma are presented. Evidence is shown of an electrostatic wave growing along the beam and decaying rapidly outside the beam. Each harmonic line exhibits a slight sensitivity to current carried by the beam. The He plasma was generated at about 1μ pressure in a 15-cm.-diam. glass pipe by a 1-cm.-diam. electron beam. Waveguide horn and small movable r-f monopole antennas were used. (R.E.U.)

19146 RELATIVE OSCILLATOR STRENGTHS OF SOME O_{II} AND O_{III} LINES FROM MEASUREMENTS ON SHOCK-HEATED PLASMAS. H. F. Berg, K. L. Eckerle, R. W. Burris, and W. L. Wiese (National Bureau of Standards, Washington, D. C.). Astrophys. J., 139: 751-7(Feb. 15, 1964).

The layer of plasma behind reflected shock waves, which were produced in a T-tube filled with a helium-oxygen mixture, served as a high-temperature light source for the measurement of relative oscillator strengths of some O_{II} and O_{III} lines. Densities and temperatures were determined using the line-broadening data of some neutral and ionized helium lines as well as their relative intensities. Some relative O_{II} and O_{III} oscillator strengths were then determined by intensity measurements, using a scanning technique. The O_{II} results compared very well with previous work employing a high-current arc. Furthermore, for all measured oscillator strengths, theoretical values were obtained from the Coulomb approximation. The relative values from theory and experiment were found to be in satisfactory agreement. Absolute O_{III} oscillator strengths could not be given with certainty due mainly to the rapid time characteristics of the source, which made the establishment of an equilibrium population in the second ionization stage of oxygen uncertain. (auth)

19147 AN EXPERIMENTAL STUDY OF A MAGNETO-GASDYNAMIC CHANNEL FLOW WITH AXIAL SYMMETRY. Kyoichi Kuriki (Tokyo Univ.). Bull. Aeronaut. Res. Inst., Tokyo Univ., 3: (Special Issue) A52-5(Sept. 1963). (In Japanese)

An arc-heated plasma flow which can be considered to be ~ one-dimensional, was produced in a glass pipe. It was found to be subsonic or supersonic depending on the arc current. Preliminary measurements of the temperature, velocity, and static pressure and calculations of the electrical and thermodynamical properties were made. To study the magnetic channeling effect and the magnetic piston, the magnetic field produced by a ring coil was selected to interact with the plasma flow. A linearized theory, which assumes small changes in electrical and flow variables, and which neglects Hall effects and charge separation, was calculated for the variation of the wall pressure and gas luminosity. The experimental results were in good agreement with those of frozen flow theory. A remarkable contrast was observed between subsonic and supersonic flows, just as predicted by the linearized theory. The magnetic channeling effect was recognized near the wall of the channel. (from NSA of Japan)

19148 THE EFFECT OF THE MAXWELL DISPLACEMENT CURRENT IN THE PROPAGATION OF MAGNETOHYDRODYNAMIC WAVES. John Carstoiu (Science for Industry, Inc., Brookline, Mass.). Compt. Rend., 258: 1728-31(Feb. 10, 1964). (In French)

The effect of the Maxwell displacement current on the propagation of magnetohydrodynamic waves is studied by considering the case of a nonviscous perfectly conducting fluid. (J.S.R.)

19149 THE EFFECT OF A TRANSVERSE MAGNETIC FIELD ON SEPARATION. René Moreau (Université, Grenoble, France). Compt. Rend., 258: 1732-5(Feb. 10, 1964). (In French)

An approximate general criterion for magnetohydrodynamic separation is obtained. The conditions under which the separation point is suppressed are deduced in three examples. The effect of the transverse magnetic field on the separation is shown. (tr-auth)

19150 THE SYMMETRIC FLOW OF A CONDUCTING FLUID ACROSS A MAGNETIC FIELD. A. I. Morozov and L. S. Solov'ev. Dokl. Akad. Nauk SSSR, 154: 306-9(Jan. 11, 1964). (In Russian)

The magnetohydrodynamic equations are presented for the plane flow and axially symmetric flow of a conducting compressible fluid along the equipotential lines of an electric field. It is assumed that the fluid has zero viscosity and thermal conductivity. For the case of flow in an axially symmetric channel it is shown that the flow lines of the fluid and the lines of flow of electric current are orthogonal. Some of the results are applied to plasma acceleration. (TTT)

19151 INTERNAL RESONANCES OF A DISCHARGE COLUMN. F. W. Crawford (Stanford Univ., Calif.). J. Appl. Phys., 35: 1365-9(May 1964).

Dipole resonance of a cold plasma column can be predicted quite simply and observed experimentally. It is normally accompanied, however, by a series of subsidiary resonances. These were recently explained phenomenologically as depending on nonuniform electron density and nonzero electron temperature for their existence. Numerical results of an analysis of the resonances by Nickel, Parker, and Gould, are compared to the recently published experimental work on which the phenomenological description was founded, and it is shown that there is very good agreement. These observations and the theory have considerable relevance to the pressure waves described by Bohm and Gross, and to the effectiveness of Landau damping under conditions of nonuniform electron density. It is also possible to use the computed data to estimate the error in dipole resonance measurements of electron density. (auth)

19152 A BACKWARD-WAVE SURFACE MODE IN A PLASMA WAVE-GUIDE. R. N. Carlile (Univ. of Arizona, Tucson). J. Appl. Phys., 35: 1384-91(May 1964).

The phase characteristics of a backward-wave pass-band mode were measured in a plasma waveguide, consisting of a circular waveguide that is coaxial with the positive column of a mercury-vapor discharge. The mode was identified as an n = 1 surface mode similar to that described by Trivelpiece. It is shown that zero-temperature plasma-waveguide theory predicts this mode accurately. This theory predicts that a simple relation exists between the lower cut-off frequency of the n = 1 mode and the electron plasma frequency. It is demonstrated that the calculated electron plasma frequency obtained from this relation, where the cut-off frequency is determined from a measurement of the phase characteristics agrees well with an independent measurement of electron plasma frequency by the well-known cavity-perturbation method. Both the n = 1 and symmetric n = 0 modes were excited by a novel coupler called the double ring-coupler. Noise measurements on the n = 1 and symmetric n = 0 modes indicate that the output signal to noise ratio is independent of input signal power and is about 7 db for the n = 1 mode and varies from about 7 to greater than 30 db for the n = 0 mode. A simple model of the plasma is proposed which explains all the noise observations reported here. (auth)

19153 MICROWAVE DETERMINATION OF AVERAGE ELECTRON ENERGY AND DENSITY IN He–Ne DISCHARGES. E. F. Labuda and E. I. Gordon (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 35: 1647-8(May 1964).

Microwave measurements were made on the positive column of a d-c He–Ne discharge to determine the electron density and average energy as a function of discharge current, tube diameter, and fill-gas. The techniques used in the measurements are described. (R.E.U.)

19154 INTERFEROMETRIC MEASUREMENT OF ELECTRON DENSITY IN A HIGH-CURRENT DISCHARGE. J. Dyson (National Physical Lab., Teddington, Middx., Eng.), R. V. Williams, and K. M. Young. J. Nucl. Energy, Pt. C, 6: 105-22(Mar.-Apr. 1964).

An optical interferometric method was used to measure the electron density in Sceptre IV for various discharge conditions. The interferometer, which was of the common-path type, was used in conjunction with a rotating mirror camera to find the variations of electron density, integrated across the discharge tube with respect to space and time. Mean densities of the order of 10^{14} cm^{-3} were measured. Large-scale losses and injection of particles were observed for all discharges, but otherwise the discharge behavior was very nonreproducible. Low electron densities during the discharge are associated with the mechanism producing the "bars" observed in streak photographs taken simultaneously with the interferograms. (auth)

19155 NON-LINEAR COUPLING OF PLASMA OSCILLATIONS TO TRANSVERSE WAVES. R. E. Aamodt and W. E. Drummond (General Atomic Div., General Dynamics Corp., San Diego, Calif.). J. Nucl. Energy, Pt. C, 6: 147-51(Mar.-Apr. 1964).

The energy transfer rate from longitudinal oscillations into electromagnetic energy due to nonlinear effects in a collisionless, homogeneous, isotropic plasma is calculated. It is found that the radiation is peaked around $2\omega_p$, and the energy transfer for systems having either a thermal or a mild two-stream instability 'equilibrium' spectrum of longitudinal oscillations is estimated. (auth)

19156 STRONG IONIZING FRONT IN A MAGNETIC FIELD. J. E. Allen and S. E. Segre (Euratom-CNEN, Frascati, Italy). J. Nucl. Energy, Pt. C, 6: 153-9(Mar.-Apr. 1964).

The propagation of an ionizing front into a neutral gas containing a magnetic field is considered. It is assumed that the gas behind the front is completely ionized and hence a good conductor and that it is driven by a constant external magnetic field. A solution is found for the case of a plane wave moving into an infinite gas at constant velocity, the initial magnetic field being uniform and perpendicular to the direction of the subsequent motion. A perfect gas is assumed. (R.E.U.)

19157 MOBILITY AND TEMPERATURE OF THE ELECTRONS AND IONS IN A WEAKLY IONIZED GAS. J. Salmon (Université, Caen, France). J. Phys. (Paris), 24: 1118-26(Dec. 1963). (In French)

A method of moments is presented by which the mobility and temperature of ions and electrons in a slightly ionized plasma can be determined. For the ions, satisfactory agreement with experiment is obtained using an interaction law of the hard-sphere type. For the electrons, a correction factor must be introduced. (auth)

19158 A METHOD OF APPROXIMATION FOR LANGMUIR PROBES. Thong Saw Pak (Univ. of Malaya, Kuala Lumpur). J. Sci. Instr., 41: 180-1(Mar. 1964).

The use of a Langmuir probe in the study of an electric

plasma is restricted to probes with a flat collecting area. For probes with other shapes a saturation of the ion current is not obtained. Since the electron probe current is made up, in part, of an electron equivalent of the saturated ion current, a knowledge of its value is necessary for probe analysis. A method of approximation is proposed by which this difficulty can be surmounted. In this method log i + log $(1 + i'/i)$ is substituted for log i_e. Experimental results show that the method can be used and is applicable to all shapes of probes. (auth)

19159 NON-LINEAR EFFECTS OF FLUCTUATION OF THE ELECTRON DISTRIBUTION IN THE PHENOMENA OF RESONANCE PROBE. Yoshi H. Ichikawa (Nihon Univ., Japan). Kakuyugo Kenkyu, 11: 436-46(Nov. 1963). (In Japanese)

The theory of resonance probes was developed with the basic assumption that the most important effect in resonance phenomena is a linear response of the electron distribution in a plasma to the oscillating potential superposed on the probe. In the present paper, the effects of a nonlinear response of the electron distribution are examined by applying the van der Pol-Bogaliubov-Krylov expansion method. (from NSA of Japan)

19160 A GENERALISATION OF FRESNEL'S EQUATIONS FOR THE EXTRA-ORDINARY MODE IN A PLASMA. F. W. Sluijter (FOM-Instituut voor Plasma-Fysica, Jutphaas, Netherlands). Phys. Leters, 9: 22-3(Mar. 15, 1964).

Fresnel's equations are generalized for the case where a longitudinal component of the electric field of the plasma wave is present. A semi-infinite, collisionless, low temperature plasma slab consisting of electrons against a fixed neutralizing background is considered. (C.E.S.)

19161 INFLUENCE OF A CYLINDRICAL GLASS TUBE ON THE MICROWAVE FIELD IN THE REGION OCCUPIED BY THE PLASMA COLUMN. J. Datlov, V. Kopecky, and J. Musil (Inst. of Plasma Physics, Prague). Phys. Letters, 9: 24-6(Mar. 15, 1964).

The possibility of making full use of the focusing effect of a cylindrical glass tube in which the parameters of a plasma column are measured is investigated. A cylindrical glass tube was placed between the rectangular apertures of two horn antennas. The distribution of electromagnetic energy in the plane perpendicular to the optical axis of both horn antennas was investigated at different distances of sending and receiving horn antennas by means of a probe. (C.E.S.)

19162 EFFECT OF ELECTRON–ELECTRON CORRELATIONS ON OSCILLATIONS IN A COMPLETELY ISOLATED PLASMA. J. Coste (Université, Paris). Phys. Letters, 9: 34(Mar. 15, 1964). (In French)

The longitudinal dielectric constant of a completely ionized plasma derived from the kinetic equations of Guernsey and the dielectric constant derived from the Vlasov equation are used in investigating the effects of electron-electron correlations on oscillations in a completely isolated plasma. The particular case of an electron gas neutralized by a continuous positive background is considered. (C.E.S.)

19163 DIELECTRIC TENSOR FOR A QUANTUM PLASMA. Don C. Kelly (Yale Univ., New Haven). Phys. Rev., 134: A641-9(May 4, 1964).

The dispersive properties of a plasma in a uniform magnetic field are investigated using a quantum distribution function (Wigner function). The Wigner function is shown to satisfy the Boltzmann-Vlasov equation in the long-wavelength approximation. The dielectric tensor is evaluated at T = 0°K for waves propagating along and across the magnetic field. It is conjectured that a simple quantized kinetic theory is applicable in areas previously explored only by more sophisticated means. (auth)

19164 PLASMA EQUATION OF STATE. Fred Shure (Princeton Univ., N. J.). Phys. Rev. Letters, 12: 353-4 (Mar. 30, 1964).

The equation of state for an electron gas in a positive background is derived. The difficulty previously encountered is shown to be the result of a misinterpretation of the asymptotic solution of the differential equation for the two-particle correlation. (L.B.S.)

19165 SOME PROPERTIES OF PLASMA PRODUCED BY LASER GIANT PULSE. William U. Linlor (Hughes Research Labs., Malibu, Calif.). Phys. Rev. Letters, 12: 383-5(Apr. 6, 1964).

Production of plasma by the action of a laser giant pulse on aluminum, gold, carbon, and tungsten targets is described. Absorption of the laser energy by the plasma was measured. In the presence of magnetic fields, diamagnetic signals from the trapped plasma were measured, and time-exposure photographs of the light emitted from the plasma region were taken. (L.B.S.)

19166 STEEPENING OF LARGE-AMPLITUDE ALFVÉN WAVES. Forrest I. Boley and Peter R. Forman (Univ. of California, Berkeley). Phys. and Rev. Letters, 12: 385-8(Apr. 6, 1964). (UCRL-11174)

Steepening of the leading slopes of large-amplitude Alfvén waves in a highly ionized plasma, resulting from increased distortions of the initial sinusoidal wave field, b_θ, as points of larger b_θ overtake the lower portions of the wave, is investigated. An expression for the ratio of the steepened wave front to the corresponding slope of the unsteepened wave, from which the steepening time is calculated, is given. The wave steepening is observed by probe measurements of $\partial b_\theta/\partial t$ and b_θ and compared with calculated values. The experimental apparatus is shown. (L.B.S.)

19167 DIFFERENTIAL MOTION OF EXCITED He^+ IONS IN A HOLLOW CATHODE PLASMA. F. L. Roesler and Linda DeNoyer (Univ. of Wisconsin, Madison). Phys. Rev. Letters, 12: 396-8(Apr. 6, 1964).

A high-luminosity pressure-scanned photoelectric Fabry-Perot spectrometer was used to analyze the He II (3s,p,d,)-(4s,p,d,f) line complex excited in a liquid helium-cooled plasma for a differential shift of the position of the lines. The experimental results for the line separations and shifts of individual lines with field reversal are tabulated. It is postulated that the shift is a Doppler shift caused by ion motion along the small axial electric field in the plasma, and that the differential shift is caused by a dependence of the probable velocity of an ion at the time of emission upon its l value. (L.B.S.)

19168 RESONANT BEHAVIOUR OF A PLASMA SLAB-CONDENSER SYSTEM. II. COMPARISON BETWEEN EXPERIMENTS AND THEORY. A. M. Messiaen and P. E. Vandenplas (Ecole Royale Militaire, Brussels). Physica, 30: 303-8(Feb. 1964).

A mercury discharge tube was used in the construction of a plasma slab-condenser system. The main resonance and antiresonance frequencies were determined and were found to be in good agreement with previous theoretical calculations. (C.E.S.)

19169 STUDIES OF THE DYNAMIC PROPERTIES OF LANGMUIR PROBES. III. DISCUSSION OF THE RESULTS.

H. J. Oskam, R. W. Carlson, and T. Okuda (Univ. of Minnesota, Minneapolis). Physica, 30: 375-86(Feb. 1964).

The results obtained during the study of the dynamic properties of a Langmuir probe are discussed. Since a mathematical description of the transient behavior of a space-charge sheath is very complicated if not impossible, a qualitative theory explaining all phenomena observed is presented. This theory is based on the relatively slow motion of positive ions with respect to that of the electrons as well as on the transient distortion of the plasma region adjacent to the probe-plasma sheath. It is found that the plasma distortion may have a large influence on the probe current collection when the final probe potential is close to plasma potential. In the same region there is a possibility that transient space-charge barriers, which prevent charged particles temporarily from being collected by the probe, are produced by a sudden change in probe potential. (auth)

19170 ON PLASMA STABILITY IN AXIALLY VARYING STRONG LONGITUDINAL FIELDS. Yu. V. Vandaruov. Prikl. Mat. i Mekhan., 28: 68-78(Jan.-Feb. 1964). (In Russian)

Magnetohydrodynamic equations considering magnetic viscosity were used for resolving the problem of plasma cylinder stability in a magnetic field that varies periodically along the symmetry axis. The problem was considered in first approximation, considering only perturbations that did not distort the field. Plasma pressures were assumed smaller than the magnetic pressures. Infinitely small Larmor radius stabilization, in which hydrodynamic plasma behavior is described by an equation for a single fluid in a conducting medium, was investigated as well as the stability of plasma with uniform ion and electron temperatures and large Larmor radius. (R.V.J.)

19171 FREQUENCY DEPENDENCE OF THE RESISTIVITY OF A FULLY IONIZED PLASMA. D. A. de Wolf (Princeton Univ., N. J.). Proc. IEEE (Inst. Elec. Electron. Engrs.), 52: 197(Feb. 1964).

A graph of the classical frequency dependent resistivity for long wavelength waves in a fully ionized, equilibrium, hydrogenic plasma is presented as a function of frequency. For wavelengths that are long compared to the Debye length $\lambda_D = (4\pi ne^2/\theta)^{-\frac{1}{2}}$ the collisional contribution to the resistivity dominates the Landau damping. (P.C.H.)

19172 ON CONSTRUCTION OF THREE-DIMENSIONAL SOLUTIONS OF MAGNETOGASDYNAMICS FROM TWO-DIMENSIONAL SOLUTIONS OF GASDYNAMICS AND MAGNETOGASDYNAMICS. J. N. Kapur (Indian Inst. of Tech., Kanpur, India). Proc. Natl. Inst. Sci. India, Pt. A, 28: 336-46(Mar. 26, 1962).

A general method of constructing three-dimensional solutions of magnetogasdynamics from two-dimensional solutions of gasdynamics and magnetogasdynamics is given. The conditions under which transverse velocity and magnetic fields can be superposed on two-dimensional flows have been obtained and, in the incompressible case, explicit expressions for the most general fields of this type have been given. (auth)

19173 EXPERIMENTAL STUDY OF FAST HYDROMAGNETIC WAVES IN AN ARGON PLASMA. D. F. Jephcott and A. Malein (United Kingdom Atomic Energy Authority, Abingdon, Berks, Eng.). Proc. Roy. Soc. (London), Ser. A, 278: 243-55(Mar. 24, 1964). (CLM-P28)

In the experiments fast hydromagnetic waves are excited by discharging a capacitor through a single-turn coil surrounding a cylindrical column of magnetized argon plasma. The plasma column is 200 cm. long and 22 cm. in diameter, and the axial magnetic field strength is varied in the range from 1 to 6 kG. The wave amplitude is typically 10 G, and the frequency is varied between 1.2 and 6 times the ion cyclotron frequency. Measurement of the radial variation and the relative amplitudes of the three components of the wave magnetic field shows that the oscillation is the lowest axially symmetric mode. As predicted by the theory, the wave is elliptically polarized in the $r\theta$ plane with the magnetic vector rotating in the same sense as the electron cyclotron rotation. The experimental results demonstrate the cut-off of this mode both as the frequency is decreased and as the axial magnetic field strength is increased. Measurements of the axial wave number and absorption coefficient are in good numerical agreement with theoretical dispersion curves computed from the measured plasma parameters. This work provides quantitative evidence to support the theories currently used in treating hydromagnetic oscillations, both stable and unstable, of magnetized plasmas. (auth)

19174 METHOD OF MEASURING THE VELOCITY OF A CONTINUOUSLY FLOWING PLASMA. J. A. Cooney (Radio Corp. of America, Princeton, N. J.). Rev. Sci. Instr., 35: 442-4(Apr. 1964).

A method of measuring the mean velocity of a flowing plasma is described. In this method "blobs" of plasma are extracted from the body of the flow by an electrostatic gating technique. Then the time of flight of the "blob" for a given distance is measured. Measurements of plasma velocities of 2×10^5 cm/sec have been made at total particle densities of $10^{12}/cm^3$. (auth)

19175 TECHNIQUE FOR DETERMINING DENSITY DISTRIBUTION IN LOW PRESSURE, HIGH TEMPERATURE GASES. C. A. Ziegler (Parametrics Inc., Waltham, Mass.), L. L. Bird, K. H. Olson, J. A. Hull, and J. A. Morreal. Rev. Sci. Instr., 35: 450-6(Apr. 1964).

A new technique for measuring the point-by-point density distribution in a high temperature gas that is applicable to plasma jet facilities and hypersonic wind tunnels has been developed. An electron beam probe is directed into the plasma, and the observed number of bremsstrahlung x rays created in a given segment of the beam via electron-gas atom interaction provides a direct measurement of gas density in terms of the number of atoms per unit volume. The method provides good spatial resolution, and density determination is independent of gas temperature, chemical form, and the degree of dissociation and ionization. (auth)

19176 THE DISPERSION EQUATION OF A VISCOUS FLUID WITH FINITE ELECTRICAL CONDUCTIVITY IN UNIFORM ROTATIONAL MOTION. Mircea Vasiu. Studia Univ. Babes-Bolyai, Ser. Math. Phys., 8: No. 2, 117-31 (1963). (In Rumanian)

The dispersion equation for a compressible, totally ionized, homogeneous, infinite fluid in uniform rotational motion under the influence of a uniform magnetic field and its own gravitational field is first derived without consideration of the displacement current. The equation for a fluid with infinite electric conductivity (all other conditions the same) is then obtained, taking into account the displacement current. (D.C.W.)

19177 HIGH-TEMPERATURE PLASMA RESEARCH AND ITS PROSPECTS IN CZECHOSLOVAKIA. Jan Vana. Vestn. Cesk. Akad. Ved., 72: 558-62(1963).

A brief review is given of the state of international research on plasma physics. Original studies made by the UVE Institute of Vacuum Electronics since 1957 are reviewed briefly, and its research program for 1964–1970 is outlined in general. An agreement to coordinate plasma re-

search and nuclear research between the Soviet Union and Czechoslovakia is being prepared. (OTS)

19178 FORMATION OF A VIRTUAL CATHODE IN AN ELECTRON BEAM PASSING THROUGH A PLASMA. M. V. Nezlin. Zh. Eksperim. i Teor. Fiz., 46: 36-42(Jan. 1964). (In Russian)

The nature of instability of an intense plasma beam in a strong magnetic field observed previously, which is the cause of effective acceleration of ions across a magnetic field, is analyzed. It is shown by direct experiment that this instability is manifested in the formation of a virtual cathode in the beam of fast electrons passing through the plasma column. (auth)

19179 CONDITIONS FOR HEATING UP OF A PLASMA BY THE RADIATION FROM AN OPTICAL GENERATOR. N. G. Basov and O. N. Krokhin (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 46: 171-5(Jan. 1964). (In Russian)

Various processes accompanying a rapid pulsed heating of small volumes of a plasma by the radiation of a quantum generator are considered. The power and duration of the radiation pulse required for heating a hydrogen plasma to temperatures of the order of 10^8-10^7 degrees are estimated. (auth)

19180 THEORY OF TRANSFORMATION AND SCATTERING OF ELECTROMAGNETIC WAVES IN A NONEQUILIBRIUM PLASMA. I. A. Akhiezer, I. A. Danelia, and N. L. Tsintsadze. Zh. Eksperim. i Teor. Fiz., 46: 300-6(Jan. 1964). (In Russian)

Transformation and scattering of electromagnetic waves in a nonequilibrium plasma is investigated. If the plasma is in an almost unstable state, the wave scattering and transformation coefficient will be anomalously large. A plasma with hot electrons moving with respect to cold ions and a plasma through which a fast beam of charged particles is passing are considered. The problem of spontaneous glow of a nonequilibrium plasma due to transformation of fluctuation longitudinal waves into transverse waves is investigated. (auth)

19181 DAMPING OF A LONGITUDINAL NONLINEAR MONOCHROMATIC WAVE IN A WEAKLY IONIZED PLASMA. R. Ya. Kucherov. Zh. Eksperim. i Teor. Fiz., 46: 368-73(Jan. 1964). (In Russian)

Damping of a nonlinear monochromatic longitudinal wave due to collisions between electrons and neutral atoms is considered. The distribution functions of the resonance particles and the damping decrement of the wave are calculated. (auth)

19182 ENERGY ABSORPTION DUE TO TWO-STREAM INSTABILITY OF THE PLASMA IN A TOROIDAL SYSTEM. S. D. Fanchenko, B. A. Demidov, N. I. Elagin, and D. D. Ryutov. Zh. Eksperim. i Teor. Fiz., 46: 497-500 (Feb. 1964). (In Russian)

A toroidal plasma arrangement with longitudinal magnetic and electric fields is described. Data are presented that pertain to measurement of the high frequency discharge current, circuit voltage, light, and x-ray emission. The anomalous resistance of the collisionless plasma is assumed to be due to the two-stream instability. (auth)

19183 SOME NEW RESULTS ON TURBULENT HEATING OF A PLASMA. M. V. Babykin, P. P. Gavrin, E. K. Zavoiskii, L. I. Rudakov, V. A. Skoryupin, and G. V. Sholin. Zh. Eksperim. i Teor. Fiz., 46: 511-30(Feb. 1964). (In Russian)

The results of some new experiments on turbulent heating of a plasma are presented and a theory of this phenomenon is proposed. For concentrations between 10^{12} and 10^{13} cm^{-3} the plasma electron pressure is found to be 10^{15} ev · cm^{-3} which is approximately 20% of $H^2/8\pi$. Under certain conditions electron heating is accompanied by heating of ions up to ~150 ev. The confinement time in the trap is ~130 μsec for ions with a temperature ~100 ev and is ~60 μsec for electrons with a temperature 500 ev. No strong instabilities were observed during confinement of the plasma in the trap. Ion cyclotron waves and proper oscillations of the plasma column were observed. (auth)

19184 STATIONARY RELATIVISTIC FLOW OF A PLASMA IN A MAGNETIC FIELD. A. P. Kazantsev (Inst. of Radiophysics and Electronics, Academy of Sciences, Siberian SSR). Zh. Eksperim. i Teor. Fiz., 46: 620-7(Feb. 1964). (In Russian)

Stationary finite amplitude isolated waves moving in a cold plasma at an arbitrary angle with respect to the magnetic field are considered. The waves may be of four types: large scale Alfven compression pulses, magneto-acoustic rarefication pulses, pulses of the mixed type, and small scale compression pulses corresponding to the hybrid branch of the plasma oscillations. The structure of the waves is considered and their region of existence is indicated. (auth)

19185 A QUASILINEAR APPROXIMATION AND THE CORRELATION FUNCTIONS FOR A PLASMA. S. V. Iordanskii and A. G. Kulikovskii (Inst. of Mathematics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 46: 732-44(Feb. 1964). (In Russian)

The case when the usual expressions for the correlation functions in a plasma are unstable with respect to the appearance of Langmuir plasma waves is considered. A new method for solving the equations for the higher correlation functions is employed that is based on a simple representation of the corresponding Green functions. Approximate equations for the correlation functions in which nonlinear interactions are taken into account are derived for small instability increments. It is shown that the quasilinear approximation is valid only if the instability exists in a sufficiently small region of phase velocities of the waves. (auth)

19186 CULHAM LABORATORY FOR PLASMA PHYSICS AND FUSION RESEARCH. Abingdon, Berks, Eng., United Kingdom Atomic Energy Authority Culham Laboratory, 1963. 47p.

The programs and facilities of the Culham Laboratory toward fusion research are discussed. Containment experiments including pinched discharges and magnetic traps are described. Other studies contributing to the broader science of plasma physics are discussed. (R.E.U.)

19187 COMPTES RENDUS DE LA VI^e CONFÉRENCE INTERNATIONALE SUR LES PHÉNOMÈNES D'IONISATION DANS LES GAZ, PARIS, 8-13 JUILLET 1963. VOLUME IV. (Proceedings of the VIth International Conference on Ionization Phenomena in Gases, Paris, July 8-13, 1963. Volume IV.). P. Hubert and E. Cremieu-Alcan, eds. Paris, SERMA, 1963. 566p.

Separate abstracts were prepared for 76 of 93 papers presented. Subjects not considered for NSA include photoelectric recording of spectral line profiles, measurement of ion temperature, current-voltage characteristics of high-temperature gases at high pressures, light amplification of high-speed images, measurements of d-c plasma scattering of laser radiation, noise processes in gas discharge probes, and measurements of temperature distribution in an arc between tungsten electrodes in argon. Papers previously included in NSA: 17: 5511, 13622, 31571, 33206, 36747,

39707; 18: 6308, 9459, and 15391, and one presented as NP-13699. (R.E.U.)

For abstracts of individual papers see: 18164, 18165, 18496, 18497, 18498, 18611, 18626, 18627, 18628, 18629, 18630, 19188, 19189, 19190, 19191, 19192, 19193, 19194, 19195, 19196, 19197, 19198, 19199, 19200, 19201, 19202, 19203, 19204, 19205, 19206, 19207, 19208, 19209, 19210, 19211, 19212, 19213, 19214, 19215, 19216, 19217, 19218, 19219, 19220, 19221, 19222, 19223, 19224, 19225, 19226, 19227, 19228, 19229, 19230, 19231, 19232, 19233, 19234, 19235, 19236, 19237, 19238, 19239, 19240, 19241, 19242, 19243, 19244, 19245, 19246, 19247, 19248, 19249, 19250, 19251, and 19252.

19188 MEASUREMENT OF LOCALIZED DENSITIES IN AN ARGON GLOW DISCHARGE. W. C. Eppers, Jr. (Electronic Tech. Div., Wright-Patterson AFB, Ohio), and R. B. Morrow. p.19-21 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

X-ray fluorescence was used to determine localized gas density in the cathode dark space of an abnormal cold cathode argon glow discharge. The measurement system utilized a collimated x-ray beam from a tungsten anode x-ray tube. The 1-mm-diam beam passed through the region in which the density was desired and the resulting fluorescent yield was detected by an appropriate proportional counter system. The density of the gas in the dark space decreased as the discharge current was increased. Densities observed were on the order of $\frac{1}{3}$ of the density computed from pressure and wall temperature. The equivalent gas temperature reached approximately 1200°K. (auth)

19189 A SPECTROSCOPIC METHOD ALLOWING SPATIAL RESOLUTION. Richard T. Schneider (Allison Div., General Motors Corp., Indianapolis). p.23-9 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

The spectroscopic method described allows spatial resolution of the observed plasma. This permits investigation of one component of a mixed gas and shows the spatial particle density distribution of atoms having the energy of a certain excited state. The information is spread over a wide range and provides better transformation from axial into radial intensity distribution. A luminous sheath on the cathode is observed by the method; the composition of the sheath is determined. Variation of sheath thickness with varying discharge current is shown. The experimental setup permits a line spectrum to be obtained from any desired spatial location, thus allowing measurement of line broadening and line intensity. The method is applicable to thermionic converters and to MHD-power generators. (auth)

19190 MEASUREMENT OF MAGNETIC FIELDS IN A PLASMA USING THE ZEEMAN EFFECT. Klaus Huebner (Institut für Plasmaphysik, Garching, Ger.). p.31-3 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

The longitudinal normal Zeeman effect allows optical measurement of magnetic fields even with line-widths larger than the splitting. The two components are separated into two different spectra. Three simultaneous measurements of intensities give both the product of the magnetic field and the line-slope, and the line-slope alone. The time-dependent magnetic field is calculated from these two quantities. This method is independent of time-variations in intensity, line-profile and line-shifts. Test measurements were made in a nitrogen discharge with time-varying external magnetic fields. (auth)

19191 TIME-RESOLVED INTERFEROMETRIC MEASUREMENTS OF EMISSION LINE PROFILES FROM TRANSIENT DISCHARGES. N. J. Peacock (Culham Lab., Eng.). p.35-40 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

A scanning, Fabry-Perot interferometer was used to study the growth and decay of plasma produced in a critically damped Z-pinch. The profiles of the emission lines are scanned in times less than a microsecond by displacement of one plate of the interferometer that is attached to a piezoelectric element driven in resonance. Because of its high inherent luminosity, the technique is applicable to the study of highly transient plasmas. The electron density is estimated from the Stark-broadened H_β and He II lines and the results are compared with densities measured by other techniques. Instrumental factors affecting the line widths are considered. (auth)

19192 SPECTROSCOPIC TECHNIQUES OF TIME RESOLUTION FOR A STUDY OF FAST Θ-PINCH DISCHARGE. A. de Angelis, S. Martellucci, and G. Tondello (Université, Padua). p.41-5 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In Italian)

Two devices employed for time-resolved analysis of line profiles and respective intensity ratios of spectral lines are described. For profile measurements, the chosen line, emerging from a monochromator, is projected on the front edge of ten perspex light guides through an anamorphic lens; the rear terminal of each guide goes to a photomultiplier and oscilloscope. The second device has two similar guide pairs, with the front edge in the focal plane of a Littrow prism spectrograph; the first guide in each pair picks up the total light from the line of interest, the second one measures the continuum nearby. The device enables measurements in any part of the visible region. The apparatus are employed for electron density and temperature determination of a helium plasma generated with a fast θ-pinch discharge. (auth)

19193 A DOUBLE-PROBE TECHNIQUE FOR DETERMINING ELECTRON VELOCITY DISTRIBUTIONS. F. W. Crawford, A. Garscadden, and R. S. Palmer (Aeronautical Research Labs., Wright-Patterson AFB, Ohio). p.53-6 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

The second derivative of a Langmuir probe characteristic can be used to determine the electron velocity distribution in the discharge. Several methods were used in the past to obtain this derivative. The techniques were often seriously affected by the presence of fluctuations in the discharge parameters, and some of them have involved relatively complex circuitry. A simple double-probe method is described by which the first derivative can be obtained with good discrimination against fluctuations. The second derivative can then be obtained electronically. The method was tested in mercury-vapor and rare gases. Factors affecting the accuracy with which the derivatives can be obtained in practice are discussed, and some preliminary results are given for the electron velocity distribution in a striated discharge in neon. (auth)

19194 LANGMUIR PROBE IN MAGNETIC FIELD: ELECTRON CURRENT. J. Virmont (Ecole Polytechnique, Paris). p.63-5 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In French)

It was previously shown that the electrons collected by a probe come from a long tube of force, whose section is about one Larmor radius larger than the probe, and that is fed by diffusion. The size of the tube is confirmed. The plasma density is found to be deeply lowered far out of the tube; electrons do not get far into the tube, which is not neutral. The calculation of the electron temperature from probe characteristics is justified. The difficulty of expressing completely the electron current is shown. (auth)

19195 ELECTRON DENSITY AND TEMPERATURE MEASUREMENT IN THE PRESENCE OF A MAGNETIC FIELD. H. Doucet and H. Lamain (Ecole Polytechnique, Paris). p.67-9 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In French)

Electron density in a pulsed reflex discharge at low pressure is determined by magnetic flux measurements. These results agree with other measurements. (auth)

19196 THE ENERGY SPECTROMETER AS A TOOL FOR PLASMA DIAGNOSIS. H. Heil (Hughes Research Labs., Malibu, Calif.). p.71-4 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

By extracting representative samples of either electrons or ions out of a plasma and by subsequent energy analysis, accurate information about the electron and ion energy distribution can be obtained. In particular, the high energy tail of the electron distribution can be recorded, and from ion energy analysis one can deduce the plasma potential. Neither of these two measurements is deducible from probe characteristics or readily obtainable by other diagnostic means. The carrier extraction process is discussed and the spectrometer used for the energy analysis is described. (auth)

19197 DETERMINATION OF ELECTRON DENSITY AND ENERGY DISTRIBUTION IN A VERY HOT ELECTRON PLASMA. W. B. Ard, A. C. England, R. A. Dandl, and R. J. Kerr (Oak Ridge National Lab., Tenn.). p.75-8 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

A method of determining the spatial distribution of energy and density in a hot electron plasma was used that consists of dropping a probe through the plasma that collects essentially all the electrons. The probe is a small metallic sphere. The particle current to the sphere is monitored indirectly by observing the x rays emitted from the sphere and at the same time measuring the rate at which energy is lost by the plasma. In the experiment, $\frac{1}{8}$ in-diam stainless steel spheres are dropped from a distance of 2 ft above the center of the plasma. A well collimated x-ray counter aimed along the axis of the magnetic field records a burst of x rays when the sphere crosses the axis of the field. This x-ray burst serves as a timing marker. The change in energy in the plasma is determined by measuring the emf induced in a coil surrounding the plasma. The total x-ray production is measured by a scintillation counter located near the plasma. The outputs from these detectors are displayed simultaneously on a fast multichannel recorder. (auth)

19198 APPLICATION OF PHOTOELECTRIC INTERFERENCE SPECTROSCOPY AND IMAGE INTENSIFIERS TO PLASMA DIAGNOSIS. D. J. Bradley, B. Bates, and C. O. L. Juulman (Imperial Coll. of Science and Tech., London). p.79-83 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

A method of employing a Fabry-Perot interferometer-image intensifier combination to obtain simultaneously time, spatial, and spectral resolution is described. Comparison is made with an oscillating Fabry-Perot interferometer. Three types of image tube were tested and time resolution of 2×10^{-9} sec obtained. Causes of signal-induced background are discussed as is also the combination of an oscillating interferometer with the system. First results are given of aluminum films making possible the extension of the interferometer spectral range into the vacuum uv. (auth)

19199 EXPERIMENTAL DETECTION OF PLASMA TURBULENCE BY SHADOWGRAPH TECHNIQUE. U. Ascoli-Bartoli, S. Martellucci, and E. Mazzucato (EURATOM-CNEN, Frascati, Italy). p.97-103 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

Evidence for turbulent plasma motions is described. The shadowgraphs method was applied to a theta-pinch discharge of 13 μsec period, obtained in either hydrogen or argon at pressures ranging from 50 μHg to 10 mmHg. For reasons of intensity and time resolution a ruby laser flash of 1-Mw power and 50 nsec duration was employed as light source. The shadowgrams so far obtained clearly show inhomogeneous structures accompanying the pinch collapse and presenting considerable variations with the phase of the discharge. (auth)

19200 DEVELOPMENT OF SCHLIEREN TECHNIQUE IN PLASMA DIAGNOSTICS BY USING A PULSED RUBY-LASER. U. Ascoli-Bartoli, S. Martellucci, and E. Mazzucato (EURATOM-CNEN, Frascati, Italy). p.105-10 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

The use of a ruby laser as light source allows improvement in the Schlieren method. This method was applied to a theta pinch of ~1 kj of energy and ~13 μsec of discharge period. The gas used is argon at 0.1 to 10 torr. Schlieren pictures by Toepler's Schlieren arrangement are shown. By using a cylindrical-lens Schlieren method, quantitative measurements of the refractivity gradients were carried out. (auth)

19201 MAGNETO ROTATION OF RUBY LASER LIGHT FOR DETERMINATION OF PLASMA ELECTRON DENSITY. P. H. Grassmann and H. Wulff (Max-Planck-Institut für Physik und Astrophysik, Munich). p.113-17 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In German)

The electron density of a high-density plasma was determined by measuring the magneto-rotation of visible light emitted from a ruby laser. The value of electron density thus obtained was compared with the value derived from the shape of a spectral line using the theory of line broadening. (auth)

19202 LOCAL DETERMINATION OF PLASMA PARAMETERS IN A Θ-PINCH PLASMA BY LIGHT SCATTERING EXPERIMENTS. E. Fuenfer, W. H. Kegel, B. Kronast, and H. J. Kunze (Institut fur Plasmaphysik, Garching, Ger.). p.119-21 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

The radiation from a high-power ruby laser was imaged into a θ-pinch plasma of high electron density. The light scattered and emitted perpendicular to the incident laser beam is limited by a diaphragm, which selects a certain plasma volume. The light is analyzed by a monochromator followed by photomultipliers and oscilloscopes. In order

to suppress the large bremsstrahlung from the plasma, a differential method is used. The time resolution was limited from 0.1 to 1 μsec for the scattering signal. Excluding many possible sources of errors, the experimental results are presented and discussed. A comparison of the measurement with theoretical calculations gives an estimate of the Debye length. (auth)

19203 FINITE TRANSIT TIME EFFECT IN THE RADIO-FREQUENCY PROBE. Yoshi H. Ichikawa (National Research Council, Ottawa). p.125-8 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

Experimental studies have shown that when a small amplitude oscillating potential is superimposed on static potential of the Langmuir probe, besides the resonance increase of the direct current at the electron plasma frequency, the rectified increase of the direct current diminishes very rapidly in the high frequency region of $\omega > \omega_p$. The diminishment of the rectified direct current increase is interpreted in terms of the finite transit time effect of electrons that traverse through the sheath region. (auth)

19204 MEASUREMENTS WITH A WIDE-BAND PROBE. H. M. Mayer (Max-Planck-Institut für Physik und Astrophysik, Munich). p.129-34 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

The "plasma filled" stray capacitance at the end of a coaxial line terminating in a plasma forms a "plasma capacitor," the frequency behavior of which is investigated in a wide range (70 to 2×10^3 megacycles). Apart from damping effects the latter is roughly that of a "three slab dielectric." Operation of the "wide-band probe" as an electrostatic probe or "resonance probe" is also possible. Densities between 10^{10} and 10^{11} electrons per cm^3 obtained from electrostatic operation were in good agreement with the plasma frequencies. The d-c potential change induced by h-f between asymmetric electrodes also changes sign. Large damping effects are attributed to electron acceleration in the sheath. (auth)

19205 MEASUREMENTS WITH THE HIGH-FREQUENCY RESONANCE PROBE IN A CESIUM PLASMA. G. Peter, G. Mueller, and H. H. Rabben (Institut fur Plasmaphysik, Garching, Ger. and Max-Planck-Institut fur Physik und Astrophysik, Munich). p.147-55 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In German)

A cesium plasma was generated by contact ionization of cesium atoms on a hot tungsten surface in an apparatus named ALMA I. Measurements were made with a high-frequency resonance probe. The plasma density was in the range 10^6 to 10^9 cm^{-3}, the plasma temperature ~2000°K, and the neutral gas pressure about 10^{-6} torr. The results are presented and discussed of electron density determinations from the resonance frequency of the h-f probe, and a comparison with Langmuir probe measurements, the height of the resonance current peak as a function of the d-c probe potential and of the h-f amplitude, and the resonance frequency dependence on the direct current to the probe and on the d-c probe potential. (auth)

19206 FAR INFRARED DENSITY MEASUREMENTS. D. T. Llewellyn-Jones, S. C. Brown, and G. Bekefi (Massachusetts Inst. of Tech., Cambridge). p.157-60 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

Plasma electron densities of the order of 10^{12} electron cm^{-3} were computed from measurements of the phase shift suffered by a beam of far infrared radiation in passing through a plasma. Wavelengths used were in the region of 300μ with a resolving power of approximately 10 per cent. The measurements were made with a grating interferometer and an indium–antimonide sub-millimeter detector, taking advantage of the fast response time and high sensitivity of this detector. (auth)

19207 MICROWAVE MEASUREMENT OF ELECTRON DENSITY PROFILES IN PLASMAS. G. E. Stewart and Z. A. Kapriellan (Univ. of Southern California, Los Angeles). p.165-71 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

An investigation was conducted on the utilization of microwave cavities for determining electron density profiles in cylindrical geometries. The method consists of approximating the electron density in terms of a finite set of orthonormal polynomials of the radius with unknown coefficients and then determining the coefficients from the shifts in resonant frequency of microwave cavities into which the plasma is introduced. Measurements were made of the first two coefficients in the expansion of the electron density profile in a low pressure mercury arc discharge both with and without a magnetic field. These agreed reasonably well with theory. (auth)

19208 NEW MILLIMETER AND SUB-MILLIMETER TECHNIQUES APPLIED TO MICROWAVE DIAGNOSIS OF DENSE PLASMA DEVICES. P. E. Faugeras, R. Papoular, and B. Zanfagna (EURATOM-CEA, Fontenay-aux-Roses, France). p.173-6 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In French)

At the shorter millimeter and submillimeter wavelengths, usual waveguides (high attenuation) and optical propagation (diffraction losses, difficulties of alignment) are unsuitable for plasma diagnostics. To overcome these difficulties quasioptical propagation in oversize rectangular waveguides is used. On this basis the elements of a complete system for measuring phase shift and attenuation: attenuator, calibrated or not (0 to 50 db); calibrated phase shifter giving at least 4π; directional coupler, with fixed or variable coupling; hybrid junction; wavemeter; detector; and focusing system were developed. These elements have the following characteristics: very low attenuation, easy machining, low cost, easy alignment, and very wide band (0.5 to 5 mm). (auth)

19209 MICROWAVE REFLECTION METHOD FOR DENSE PLASMAS DIAGNOSTICS. Susumu Takeda and Takashige Tsukishima (Nagoya Univ., Japan). p.177-80 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

The principle of the microwave reflection method is based on the fact that the complex reflection coefficient at a sharp boundary of the plasma depends on an electron density higher than the critical value. The electron density and the collision frequency of transient plasmas are calculated from two microwave signals detected at two standing wave detectors in slotted waveguide sections and displayed simultaneously on a dual beam oscilloscope. Electron densities from 10^{12} to 10^{15} cm^{-3} were measured by an X-band (9000 Mc) microwave in an afterglow of argon at a pressure of 0.5 mm Hg and plasmas produced by Mach 8 to 15 shock waves in argon at a pressure of 0.1 mm Hg. (auth)

19210 MICROWAVE DIAGNOSTICS OF HIGH-SPEED PLASMA FLOWS. R. C. Warder, Jr., W. L. Nighan, M. E. Brodwin, and Ali Bulent Cambel (Northwestern Univ.,

Evanston, Ill.). p.181-8 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

An investigation of the electrical properties of argon and nitrogen high-speed plasma flows was conducted in an arc-heated plasma tunnel using microwave diagnostic techniques. Phase shift, attenuation, and Faraday rotation measurements at 78, 81.5, and 85.3 kMc were made to determine the electron density and the effective electron collision frequency. The electron densities as determined from the phase shift measurements on an isotropic plasma agree quite well at the various frequencies, and when compared with theoretical predictions, indicate that the flow is not in equilibrium. The attenuation measurements show qualitative agreement. The experimentally obtained effective electron collision frequency does not agree with present theoretical predictions. Faraday rotation experiments on a plasma with one circularly polarized component of the wave cut off yield values of electron density that agree quite favorably with those obtained from phase shift measurements on an isotropic plasma under similar conditions. (auth)

19211 A MICROWAVE-DUAL-INTERFEROMETER FOR PLASMA DIAGNOSTICS. G. Lisitano (Institut fur Plasmaphysik, Munich). p.199-201 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

An interferometer is described that radiates two microwave frequencies through a plasma in order to obtain a better approximation of the plasma density. By comparing the phase shift of the two waves it is also possible to determine the equivalent diameter of a plasma column of uniform density. The two waves used are an 8 mm fundamental wave and its first harmonic. (auth)

19212 STUDY OF ENERGY BALANCE OF REFLEX DISCHARGE. R. Basile and J. M. Lagrange (Laboratoire Joliot-Curie, Orsay, France). p.203-8 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In French)

A theoretical study is carried out of a reflex discharge source for heavy, multiply charged ions. The energy balance equation for this discharge is determined as a function of: gas flow; arc voltage; and electronic and ionic currents. The study permits the determination of the energy β necessary to create an ion in the plasma. The values of β thus determined are in agreement with experimental values. (tr-auth)

19213 ACCELERATION OF PLASMA BY A TRAVELLING WAVE. W. Bieger, P. Graff, H. Gresser, P. Noll, and H. Tuczek (Kernforschungsanlage, Julich, Ger.). p.217-21 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

The acceleration of plasma by a magnetic piston, produced by a wave traveling on a special transmission line, is investigated. A conical electrodeless ring discharge is used as plasma source, injecting the plasma into the field of the transmission line. The energies of the ions are measured by an ion spectrometer, based on the retarding field method. The measured energy distribution of the ions can be described in good agreement by a free particle model. (auth)

19214 AN INTENSE HIGHLY IONIZED PLASMA SOURCE. J. S. Luce, J. F. Detko, D. C. Gates, and D. L. Lafferty (Aerojet-General Nucleonics, San Ramon, Calif.). p.223-7 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

A study was made of a coaxial, gas-fed, hollow cathode, hollow anode (d-c) arc assembly that produces a dense, highly ionized plasma. The cathode, a hollow-tungsten cylinder, protrudes through a coaxial, water-cooled plate that serves as either the anode or an electron reflector. A diverging magnetic field is used to confine the plasma to a conical, horn-like shape. The field intensity at the cathode can be varied from 1500 to 3000 gauss. Spectroscopic analysis indicates that the ionization is essentially complete. The energy required to produce a density of $\sim 10^{14}$ ions per cm^3 was found to be as low as 350 ev/ion. (auth)

19215 A COLLISIONLESS PLASMA FOR WAVE PROPAGATION STUDIES. J. H. Malmberg, N. W. Carlson, C. B. Wharton, and W. E. Drummond (General Atomic/General Dynamics, San Diego, Calif.). p.229-33 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

A device was constructed in an attempt to provide an experimental situation adequately described by the Vlasov equation. The plasma is generated in a duoplasmatron and drifts from it into a long uniform magnetic field. The electrons are contained at the entrance end by a strong magnetic mirror and at the other end by an electrostatic field. The ions are not contained, but simply flow through the machine providing a radially defined background of positive charge. Characteristics of the machine and preliminary wave transmission experiments are discussed. (auth)

19216 EXPERIMENTAL RESULTS ON A COAXIAL ELECTROMAGNETIC SHOCK TUBE. J. A. Bakken, K. Dysthe, and J. Falnes (Univ. of Bergen, Norway). p.241-4 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

A coaxial electromagnetic shock tube is energized with 1.3 kj from a 5 μf ringing condenser bank. Different gases in the pressure range 0.05 to 5 torr are used. Kerr cell photography is employed, and external current and voltage monitored. External magnetic probes measure a moving asymmetric field. Observations indicate that a secondary discharge is set up between the electrodes, resulting in the formation of a closed plasma current loop decoupled from the external electric circuit. The mode of operation is modified by reversing the polarity. (auth)

19217 STUDY OF THE NEUTRALIZATION OF AN ION BEAM BY INJECTION OF ELECTRONS. J. F. Bonnal (CEN, Saclay, France), C. Manus, G. Spiess, and J. Caron. p.245-8 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In French)

A Kaufman type of source produces a beam of 5-kv mercury ions. Measurements on the plused beam indicate almost complete neutralization by an electron emitting filament. The experimentally determined transit time of the ions is in excellent agreement with theoretical predictions for a wholly neutralized beam whereas reduced electron injection produced an increased time-of-flight. (auth)

19218 PLASMA GUN INVESTIGATION. A. A. Kalmykov, A. D. Timofeev, Yu. I. Pankratev, V. I. Tereshin, S. A. Trubchaninov, M. G. Nozdrachev, V. A. Naboka, and B. G. Safronov (Academy of Sciences, USSR). p.255-64 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

Results are presented of investigations of plasma acceleration processes and an analysis of the plasma blobs

structure obtained from different kinds of plasma guns, such as the button gun, the conical electrode plasma gun, and the coaxial plasma gun. (auth)

19219 THE STRUCTURE OF PLASMOIDS OF COAXIAL INJECTOR. G. N. Aretov, V. S. Komelkov, M. I. Pergament, S. S. Tserevitinov, and V. I. Vasiliev (Academy of Sciences, USSR). p.265-72 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

Plasmoids, generated by coaxial injectors in all the operating conditions, are shown to have three characteristic regions: ionized gas, impurities, and neutral gas. An analysis of each region is presented. (R.E.U.)

19220 THE SOURCE OF HYDROGEN IONS FOR MIRROR-MACHINE OGRA. A. L. Groshev, V. V. Kuznetzov, N. P. Malakhov, and N. N. Semashko (Kurchatov Inst. of Atomic Energy, Moscow). p.273-9 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

Investigations of ion sources with the drawing out of ions across magnetic fields with the aim of primary receiving of atomic hydrogen ions were carried out. The current of protons reaches 2 amp at 150 kv. The influence of the low-frequency fluctuations in the discharge of the source and in the ion beam on focusing in Ogra injector was studied. On the background of noises appear the regular oscillations in the arc and in the drawing beam with the frequencies in the range of 5×10^4 to 3×10^5 cycles/sec, which are apparently connected with the excitation of acoustic waves in plasma of the discharge. (auth)

19221 PRECURSORS AHEAD OF PRESSURE DRIVEN SHOCK WAVES IN ARGON. H. D. Weymann and L. B. Holmes (Univ. of Rochester, N. Y.). p.281-5 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

Processes that can create electrons ahead of strong shock waves are photoionization of the gas, photoemission from the shock tube walls, and diffusion from the plasma behind the shock front. Using a glass shock tube and electrostatic probes outside the tube it was possible to distinguish between the precursors generated by these three processes. Experiments on light absorption and the influence of an axial magnetic field supplemented the electrostatic measurements. (auth)

19222 A MICROWAVE STUDY OF THE PRECURSOR EFFECT. J. M. P. Quinn and H. A. B. Bodin (Culham Lab., Berks, Eng.). p.287-91 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

Measurements on the rate of rise of precursor ionization ahead of an advancing shock wave in deuterium gas are described. The results are shown to be in agreement with a model in which primary radiation from the vicinity of the coil travels down the tube and produces photoionization of the gas and liberates photoelectrons from the walls. Simple expressions are derived for the rate of rise of the electron density for these two processes, and the most effective wavelength of the primary radiation is estimated to be ~100 A. In the present apparatus the results, in particular their insensitivity to changes in the gas pressure, suggest that photoemission from the walls is more important. (auth)

19223 ON THE DISSOCIATION OF HYDROGEN BEHIND A MAGNETICALLY DRIVEN SHOCK. C. T. Chang (Atomenergikommissionen. Forsogsinstitut, Riso, Denmark). p.299-302 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

On the assumption that molecular-molecular and atomic-molecular collisions are the main processes for the thermal dissociation of diatomic molecules, the relaxation distance behind a shock in hydrogen is calculated by means of the rate constant of Stupochenko and Osipov. With an initial condition of $p_1 = 0.2$ mm Hg, and $T_1 = 300$ deg. K, for a shock moving at a Mach number $M_1 \geq 25$, the relaxation distance is about 4 mm to 4 cm. Shocks of such strength are usually driven magnetically, consequently the effect of electric discharge is discussed. (auth)

19224 EXPERIMENTS ON SELF-IONIZING SHOCK WAVES IN A MAGNETIC FIELD. Y. Nakagawa (Univ. of Colorado, Boulder) and K. B. Earnshaw. p.303-9 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

The structure of a self-ionizing shock wave in He of 50μ Hg was studied experimentally. The shock wave was produced by means of an electric discharge and part of the shock tube was placed in a transverse magnetic field. By varying the strength of this magnetic field, it was possible to study the variation of the structure of the shock as well as the state of ionization behind the shock in the range of Mach number from 40 to 99.5 and of Magnetic Mach number (shock velocity/Alfvén velocity) 0.18 to 20. It was found that ionization behind the shock wave can be best explained in terms of streams of electrons and ions produced by the discharge. (auth)

19225 MEASUREMENTS OF ELECTRON CONCENTRATION AND ELECTRON TEMPERATURE DURING THE ATTAINMENT OF EQUILIBRIUM IN SHOCK-IONIZED ARGON. T. I. McLaren, J. N. Fox, and R. M. Hobson (Clarke, Chapman, and Co., Ltd., Durham, Eng.). p.311-18 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

An electrically driven 2 cm diameter shock tube was used to generate strong shock waves in argon, and a floating double probe technique applied to measure electron densities and temperatures to the shock-produced plasma. Consistently reproducible measurements were obtained and the spatial and temporal resolution of the probes provided plots of the variation in density and temperature during the buildup of ionization behind the shock. (auth)

19226 HALL e.m.f. MEASUREMENTS IN SHOCK-HEATED ARGON. P. R. Smy and H. S. Driver (Univ. of British Columbia, Vancouver). p.319-23 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

Hall emf measurements were performed on shock-heated argon plasma (shock strength = Mach 14, initial pressure 1 mm Hg) moving through a region of magnetic field (field strength ≤ 0.85 w/m^2). These measurements were performed with a wide range of currents at a constant field strength as well as with varying field strengths. It is found that the measured Hall emf is proportional to the product of field strength and plasma current as predicted by theory, and that the magnitude and distribution of ionization in the shock-heated plasma is in accord with previous results. (auth)

19227 MICROWAVE MEASUREMENTS ON SHOCK WAVES IN AIR. M. Dvir and W. Low (Hebrew Univ., Jerusalem). p.325-9 of "VI^e Conference Internationale sur les

Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

Microwave attenuation by shock waves in air was investigated in the Mach range of 8 to 12 and at pressures 1 to 5 mm Hg. It is shown that an analysis of the time dependence of the attenuation yields important information regarding the maximum electron-density, the build-up of the electron density and the beginning of the shock, the electron density near the contact surface, and the length of the heated slug section. The effects of transitions from a larger diameter shock tube to a smaller tube on the maximum microwave attention, on its time dependence, and on the Mach were studied. The effects of shorter and larger taper sections as well as abrupt transitions for various Mach numbers and initial pressures were studied. (auth)

19228 APPLICATION OF MICROWAVES IN SHOCK WAVE INVESTIGATIONS. J. B. Gerardo, L. Goldstein, and C. D. Hendricks, Jr. (Univ. of Illinois, Urbana). p.331-8 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

The production of electric discharge pressure-driven shock waves at Mach 4 to 14 in inert gases at a few mm Hg was studied by microwave techniques. (R.E.U.)

19229 SOME EXPERIMENTAL STUDIES OF COLLISIONS OF MAGNETICALLY DRIVEN SHOCKS. C. T. Chang, G. S. Hansen, and M. Popovic (Atomenergikommissionen. Forsogsinstitut, Riso, Denmark). p.339-43 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

By discharging two identical condenser banks simultaneously from both ends of a broad "rail-gun," the collision of shocks of equal strength is investigated experimentally. The collision and the state of the gas behind the colliding shock fronts are studied by photographic and spectroscopic methods. When the two condenser banks are fired with opposite polarity, a trapped magnetic field is detected in the region ahead of the incident shocks. (auth)

19230 MEASUREMENT OF THE CURRENT DENSITY BEHIND THE FRONT OF A MAGNETICALLY DRIVEN CYLINDRIC SHOCK-WAVE. O. E. Berge, W. Boetticher, G. Kleist, and U. Kogelschatz (Universitat, Kiel). p.345-7 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In German)

The contraction of a linear pinch discharge in helium at a pressure of 6 mm Hg generates a cylindrical shock wave. The distribution of the current density behind the front is measured by means of magnetic induction probes. In order to avoid any disturbance of the front in early stages of the discharge, the probes are mounted on a tube in the axis of the discharge. The measurements show that there are several current layers in the discharge. It is possible to correlate these layers to the visible structure of the discharge. The largest part of the discharge current remains near the wall due to the fast rise of the current. From the measured current density and the calculated electrical conductivity, the rate of ohmic heating is derived and compared with the heating by the shock. (auth)

19231 SHOCK WAVES AND PLASMA JETS IN A MAGNETIC BLAST TUBE. M. Cloupeau (CNRS, Meudon, France). p.349-53 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In French)

The spectrographic study of an H-type shock tube with two gases shows that for large Mach numbers the shock front practically coincides with the contact front, and that the predominant part of the luminosity arises from the discharge plasma. It is possible for the parasitic electric discharges along the length of the tube to play an important part in the ionization observed behind the front of a shock wave whose front is detached from the contact front. (tr-auth)

19232 THE STRUCTURE OF THE PLASMA CLOUD IN AN ELECTROMAGNETICALLY DRIVEN SHOCK TUBE. G. Brederlow (Institut fur Plasmaphysik, Garching, Ger.). p.355-9 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

In an electromagnetically driven shock tube the velocity of the luminous front of the plasma cloud that is traveling down the tube and the flow velocity of the plasma, which is following this front, were measured. By comparison of the two velocities one could decide if the plasma was shock-heated. The velocity of the luminous phenomenon was measured with a smear-camera. It turned out that there exists a shock wave in front of the moving discharge plasma. But only a very small part of the plasma cloud consists of shock-heated gas. The compression ratio of the shocked plasma could be measured. A good qualitative agreement was found between the measurements and the calculations by E. B. Turner, who used the Rankine-Hugoniot equations taking into account dissociation and ionization. It was also possible to measure the conductivity in the plasma cloud and the part of the preionization caused by precursor radiation. (auth)

19233 LUMINOSITY STRUCTURES OF PLASMAS IN ELECTROMAGNETIC SHOCK TUBES. A. J. Barnard and G. D. Cormack (Univ. of British Columbia, Vancouver). p.361-3 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

Kerr-cell photographs of plasmas generated in a T-type electromagnetic shock tube reveal that some features of the luminosity structure are attributable to the driving discharge, even after the current flow has ceased. Time-resolved spectroscopic observations show that materials from the discharge follow closely behind the luminous front. It is concluded that the simple shock equations cannot describe the state of the plasma throughout the region of major luminosity. (auth)

19234 THE FLOW BEHIND THE SHOCK FRONT IN A T-TUBE. J. Jeanmaire (Ernest-Mach-Institut, Freiburg, i.B.). p.365-8 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In German)

From an analysis of the shock propagation in a T-tube, it is found that the flow behind the shock front may be described by the blast wave theory of Sakurai for ambient pressures $p_0 \geq 10$ mm Hg, whereas another model, the standard homology solution, could not be verified. For the range of blast wave behavior, distributions of the flow velocity, the pressure, and the density are given. The plasma front velocities agree with the calculations. (auth)

19235 LARGE-AMPLITUDE WAVE MOTION IN THERMAL PLASMAS. P. L. Auer (Sperry Rand Research Center, Sudbury, Mass.). p.369-71 of "VI^{e} Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

The solitary symmetric compression waves first described by Adlam and Allen for a cold plasma are of considerable importance to the understanding of the shock transition region in a collision-free plasma. Based on a previous extension of the familiar adiabatic formulation, a

unified treatment of the hydromagnetic fluid equations is presented that is valid in the limit of small, but finite, gyro radius, wave amplitude, and space charge forces. It is found that in zero order of the appropriate adiabatic expansion parameter, finite plasma temperature contributes to the normal stress, in first order it gives rise to a shear term, and in second order it introduces a pseudo-viscosity. The consequences of these modifications are examined for stationary quasi-neutral solutions of the fluid equations. In terms of the resulting symmetric pulse solutions, a discussion is given of the effect of finite plasma temperature on the boundary layer preceding the shocked region and on the onset of turbulence, which ultimately results in a shocked region. Results are compared with those of previous authors. (auth)

19236 SHOCK WAVES IN LOW-DENSITY PLASMA. J. L. Bobin (CEA, Paris). p.373-6 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In French)

A search is made for a shock-wave model capable of describing the compression, in a low-density pinch, of deuterium gas. The chosen model (no collisions, high electron temperature, dissipative mechanism, and charge separation) is shown to be incompatible with the experimental results. A conceptual study is also made of a configuration in which the ion temperature is zero, and in which, therefore, there exists no long-range interaction between ions and shock waves in the usual sense. The long-range interaction between fast ions and an electron gas furnishes a criterion of the existence of this configuration. (tr-auth)

19237 PENETRATION OF A NEUTRALIZED ION-ELECTRON BEAM IN A MAGNETIC BARRIER. Jean-Michel Dolique (Centre de Physique Electronique et Corpusculaire, Orsay, France). p.415-17 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In French)

A theoretical analysis of the penetration of a neutralized ion-electron beam into a magnetic barrier is carried out. It is shown that if certain conditions are fulfilled, concerning the beam characteristics (density, speed, diameter) and the characteristics of the magnetic barrier (height, gradient), penetration is possible, with an electric polarizing field appearing that opposes the magnetic deflection. This penetration is accompanied by a loss of particles (by "scraping" the boundary of the beam), which is calculated. Upon examination of the conditions of an experimental study, a determination is made of the characteristics of impulse-operation, imposed by the characteristics of the residual gas. (tr-auth)

19238 PRELIMINARY RESULTS ON PENETRATION OF TRANSVERSE MAGNETIC FIELD BY A BEAM OF FAST PROTONS NEUTRALIZED BY ELECTRON INJECTION. R. J. Warnecke, Jr., G. Vincent, and A. Ben Sussan (CSF, Corbeville, France). p.419-29 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In French)

An experimental study was made of the penetration of a magnetic barrier by an ion beam neutralized by injection of electrons. The experimental setup comprises an ion source, optical ion focusing, optical electron injection, an electromagnet producing the transverse magnetic field, and a beam analyzing system. Experimental results are given, in pulsed operation, showing how the recorded signals evolve, with and without electron injection, and the transverse magnetic field being applied or not. Although the research is not completed, the results seem to confirm the role of the charge separation electric field. (auth)

19239 PLANE COUETTE FLOW IN RADIATION MAGNETOGASDYNAMICS. S. I. Pai (Univ. of Maryland, College Park). p.431-6 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

The fundamental equations and important parameters for plane couette flow of an ionized gas under transverse electromagnetic fields with thermal radiation effects are discussed. Explicit solutions for the fluid with constant properties are given. The velocity and magnetic field distributions depend greatly on the applied electromagnetic fields. The state variables depend greatly on the temperature range and the thermal absorption coefficient of the gas. Typical numerical examples are given. (auth)

19240 ELECTRODE AND INTERACTION PROCESSES IN MAGNETOHYDRODYNAMIC SYSTEMS. J. A. Nation, D. Medhurst, and S. W. Twaites (Central Electricity Research Labs., Leatherhead, Eng.). p.437-43 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

The emission properties of hot electrodes immersed in an arc-heated argon gas stream are discussed. It is shown that the detailed shape of current-voltage oscillograms, when a 50 cps signal is applied to a pair of electrodes, can be adequately described by thermal emission from the electrodes, and that the current flow is limited by the plasma resistance and the potential sheaths at the electrodes. An experimental technique utilizing the detailed form of these oscillograms for determination of the electron temperature is described. The effects of an externally applied magnetic field on the dynamics of the plasma produced in an electromagnetically driven shock tube are discussed. It is found that the plasma is either accelerated or retarded in the external field depending on the polarity of this field with respect to that driving the shock. (auth)

19241 EXPERIMENTAL STUDY OF INDUCTION-COUPLED MAGNETOPLASMADYNAMIC CHANNEL FLOW. K. H. Fischbeck (RCA, Princeton, N. J.), W. D. Jackson, and W. M. Gottschalk. p.445-52 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

The inductive coupling between a magnetoplasmadynamic channel flow and a circuit structure capable of supporting a traveling magnetic field was investigated experimentally. The supersonic plasma flow is obtained from a 1000-kw plasma arc torch, and a nitrogen–oxygen mixture serves as the working fluid. Potassium carbonate powder is injected into the plenum chamber of the torch to provide additional ionization. A 2-dimensional supersonic venturi nozzle provides a transition from the plenum chamber to the rectangular cross section of the linear channel test section. This section formed from electrically insulating material (transite) is 22″ in length, 1.1″ in height, and the entry with 2.6″ is linearly tapered to 3.4″ at exit. The traveling magnetic field is produced by a pair of 3-phase coil structures separated by the narrow channel dimension and supporting three wavelengths in the axial direction. Electrical excitation is obtained from three mechanically coupled 5-kw alternators, variable in frequency between 1500 and 4500 cycles per second. Measurements of plasma flow conditions, electrical conductivity, and electromagnetic power flow between the plasma and the coil structure are reported. These are compared with theoretical calculations for induction-coupled magneto-plasmadynamic channel flows and with the predicted performance for electrodeless or induction a-c power generators operating on these flows. (auth)

19242 THE INTERACTION OF A HIGH-VELOCITY IONIZED PLASMA WITH A TRANSVERSE MAGNETIC FIELD. T. I. McLaren, J. N. Fox, and R. M. Hobson (Clarke, Chapman, and Co., Ltd., Durham, Eng.). p.453-63 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

The "hairpin" double probe technique for measuring electron temperature and concentration was applied to measurements on a plasma generated by a Mach 15 shock in argon at a pressure of 0.5 mm Hg in a magnetic field of 1400 gauss. Preliminary measurements with power extraction electrodes are presented and compared with those with the double probes. (auth)

19243 THE FLOW OF HIGH-ENERGY PLASMA IN A MAGNETIC GUIDE FIELD. D. E. T. F. Ashby (Culham Lab., Berks, Eng.). p.465-8 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

A coaxial rail gun is used to inject a low-density hydrogen plasma into magnetic fields up to 3 kG. The plasma has a density in the region 10^{11} to 10^{12} cm^{-3}. It travels with a mean velocity of approximately 2×10^5 cm sec^{-1} and expands axially along the guide field. The transverse energy of the plasma is measured from the perturbation it causes in the magnetic field; a loss in this transverse energy is observed that cannot be attributed to particle loss or radiation loss. (auth)

19244 EXPANSION OF A PLASMA PUFF IN A LONGITUDINAL MAGNETIC FIELD. J. Jacquinot, C. Leloup, J. P. Poffe, and F. Waelbroeck (EURATOM-CEA, Fontenay-aux-Roses, France). p.469-75 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In French)

A theoretical model describes the expansion of a plasma puff along a homogeneous magnetic field from the knowledge of five characteristic parameters. These are deduced from five informations picked up from four magnetic loop signals. The shape and amplitude of the whole diamagnetic loop signals, the density evolution, and the total plasma momentum thus calculated, are shown to agree satisfactorily with experimental results from magnetic loops. Stark-broadening measurements, radial oscillation periods, electric probes, and ballistic pendula. (auth)

19245 THE ACCELERATION OF A PLASMA BY AN ELECTRIC FIELD USING THE HALL EFFECT. M. G. Haines (Imperial Coll. of Science and Tech., London). p.477-80 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

It is shown theoretically that, for a plasma in certain magnetic field configurations, the application of an electric field causes the ions to be accelerated to become the main current carriers. Two field configurations were studied, and preliminary experimental results confirm the mechanism. (R.E.U.)

19246 INTERACTION OF A PLASMA SOURCE WITH A UNIFORM MAGNETIC FIELD. C. M. Tchen (National Bureau of Standards, Washington, D. C.). p.481-3 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

The stationary shape of the interface separating the plasma gas and the magnetic field is investigated by balancing the gas and the magnetic pressures. The gas is assumed inviscid and infinitely conductive. The interface is found to take an eye-shape. The theory finds its application in the interaction of the solar wind with the galactic field. (auth)

19247 STREAMING OF A PLASMA IN AN INHOMOGENEOUS MAGNETIC FIELD. Erik T. Karlson (AB Atomenergi, Stockholm). p.485-6 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

A theoretical study is presented of the streaming of a plasma from a region with a homogeneous magnetic field into a region with a much stronger field, as in the solar wind interaction with the geomagnetic field. The forbidden region for the interplanetary field antiparallel to the geomagnetic field is analyzed. (R.E.U.)

19248 RAYLEIGH-TAYLOR INSTABILITY UNDER THE EFFECT OF ELECTROMAGNETIC FORCES. A. Lemaire (CEN, Saclay, France). p.487-90 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963. (In French)

The boundary between two fluids, the first being conducting and the other insulating, in crossed electric and magnetic fields is studied. When the J × B force is directed towards the insulating fluid, the situation is generally unstable. Considering small disturbances in planes containing the current lines (the latter being disturbed), it is shown that the equilibrium is indifferent when B is uniform, stable, or unstable according to whether grad B is directed towards the conducting fluid or not. For disturbances in the other direction (plane containing magnetic field lines) a Rayleigh-Taylor type instability is obtained, whose growth time is calculated as a function of the wave length of the disturbance when taking account of viscosity and of the effect of a transition region between the two fluids. (auth)

19249 HALL EFFECT IN A CYLINDRICAL PLASMA COLUMN. G. Ecker and H. Kanne (Universitat, Bonn). p.497-9 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

The effect of a transverse homogeneous magnetic field B on a stationary cylindrical plasma column in the "normal" region is considered. The problem is solved for the collision-dominated and the collision-free plasma. In both cases the core and the sheath are treated separately. The procedure is a first order perturbation theory in B. Potential and density distributions and the Hall-potential are calculated. The potential maximum and the density maximum are shifted from the axis in opposite directions. The Hall-potential decreases with decreasing pressure. (auth)

19250 EXPERIMENTS AND THEORY FOR HALL CURRENTS IN CROSSED ELECTRIC AND MAGNETIC FIELDS. Robert Hess, Philip Brockman, William Grossmann, and Joseph Burlock (NASA Langley Research Center, Langley Field, Va.). p.501-4 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

Measurements are presented of the variation of azimuthal Hall currents with increasing radial magnetic field in an axial steady arc discharge at various axial currents for pressures varying from 15 to 40 μ Hg. The increase in Hall currents to a peak with subsequent decrease can be interpreted through an increase of ion slip. The intensity of the high-frequency noise or turbulence varies approximately with Hall current and of the low-frequency noise with ion motion between collisions with neutrals. Hall currents are also measured at pressures around 15 mm Hg in a coaxial electrode configuration. (auth)

19251 CONVECTIVE INSTABILITY OF PLASMA FLOW ACROSS A MAGNETIC FIELD. H. E. Wilhelm (Allison Div.,

General Motors Corp., Indianapolis). p.505-9 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

Starting from the one-fluid and two-fluid theory, the stability of nonuniform plasma flow perpendicular to a magnetic field is investigated by the method of small perturbations. It is shown that due to the inertia force of the mean mass flow and due to the induced electron and ion streams, respectively, two types of convective flow instability exist. The growth rate of the first instability type is proportional to the gradient of the velocity of the mean mass flow. The growth rate of the second instability type is proportional to the induced electron stream velocity. The conditions for instability are derived and the dispersion of the instabilities is discussed. As an application, attention is given to plasmadynamic energy converters and accelerators. (auth)

19252 PLASMA TURBULENCE DUE TO THE IONIZATION INSTABILITY IN A STRONG MAGNETIC FIELD. E. P. Velikchov and A. M. Dykhne (Academy of Sciences, USSR). p.511-12 of "VI^e Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.

It is shown that the plasma, which is ionized by the current flowing across a strong magnetic field, will be unstable. The ionization fluctuations result in the change of the Ohm's law for the average current. It is shown that the plasma effective resistance increases proportionally with the magnetic field. (auth)

19253 A HALL CURRENT ACCELERATOR UTILIZING SURFACE CONTACT IONIZATION. E. A. Pinsley, C. O. Brown, and C. M. Banas (United Aircraft Corp., East Hartford, Conn.). New York, American Inst. of Aeronautics and Astronautics, 1964, Preprint 64-23, 11p, $1.00. (CONF-392-8)

From Aerospace Sciences Meeting, New York, Jan. 1964.

Analyses and experiments were performed on a Hall current accelerator in which ion acceleration occurs in an annular region filled with a neutral, fully ionized, nonequilibrium cesium plasma. Cesium ions are formed by surface contact ionization while electrons are introduced by a down-stream cathode. Acceleration is achieved by interaction of a radial magnetic field and an impressed axial electric field producing azimuthal electron drifts. Magnetic field strength is adjusted such that $\omega_e\tau_e \gg 1$ and the ion cyclotron radius is large compared to accelerator length. Accordingly, axial electron currents are inhibited by the magnetic field while ion currents are unaffected. Constraints on accelerator performance and design imposed by the onset of a two-stream instability are considered. Losses due to this instability can be avoided by properly choosing operating variables and accelerator size. Efficient, high-thrust-density performance is theoretically achievable at moderate specific impulse with large accelerators and high thrust levels provided that electron backflow can be held to tolerable limits. Potential advantages include high tolerance to neutral efflux and low ionizer heater requirements. Preliminary tests were conducted at a number of operating points on an experimental accelerator and ion source under conditions of exhaust beam current neutrality. (auth)

19254 PLASMA SWITCHING ELECTRIC DISCHARGE TUBE. (to U. S. Atomic Energy Commission). British Patent 953,524. Mar. 25, 1964. Priority date Mar. 2, 1962, United States.

An apparatus for generating, heating, and containing a plasma is designed in which the plasma is maintained free from contamination and is subjected to extremely intense heating. Plasma contamination by insulators is prevented by generating the plasma in a pinch tube and then removing the portion of the plasma adjacent the insulators. Maximum heating is obtained by delaying the formation of the plasma column until the peak current is passing through the device. The apparatus comprises a closed outer conducting cylinder with one of the ends being an insulator, an inner conducting cylinder within the outer cylinder and transpiercing the insulator, a disk electrode spaced from the end of the inner cylinder, and conductors connecting the disk electrode with the outer cylinder. The operation of the apparatus is discussed. (D.L.C.)

19255 ELECTRICAL PROPERTIES OF ABLATING SOLID MATERIALS OF LOW RESISTIVITY IN A PLASMA JET. Mark Phillips Freeman (to American Cyanamid Co.). U. S. Patent 3,127,502. Mar. 31, 1964. Filed Aug. 8, 1961.

A method is given for measuring the plasma temperature in a plasma jet stream. The method comprises placing a probe of the ablating or non-ablating type into an electrical circuit with one of the electrodes of the plasma generator and measuring the specific electrical conductivity of the plasma. Electrical circuits for use with ablating and non-ablating probes are shown. (D.L.C.)

19256 STABILIZATION DEVICE FOR SELF-COMPRESSED PLASMA COLUMN. V. S. Dergalov. Russian Patent 158,026.

A stabilization device is described for a pinched plasma column in a toroidal discharge chamber in the presence of a stabilizing external longitudinal magnetic field. To eliminate instability, two ring-shaped electrodes, electrically insulated from the chamber wall and the plasma, are affixed to the inner surface of the toroidal chamber. Different polarity potentials creating a nonhomogeneous transverse electric field are then applied to the electrodes. (OTS)

Shielding

19257 (BRL-1224) DEPENDENCE OF NEUTRON ALBEDOS UPON HYDROGEN CONTENT OF A SHIELD. Frank J. Allen, Arnold Futterer, and William Wright (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Oct. 1963. 56p.

Curves are presented by which the neutron number current, number flux, energy, and dose albedos as functions of the hydrogen content of a shield material can be determined. The curves are given for incident energies of 0.1, 0.25, 0.50, 1.0, 2.0, 3.0, 5.0, and 14.0 Mev and incident angles of 0, 30, 45, and 70° for each energy. A method is presented by which changes in neutron albedos caused by changes in cutoff (or effective cutoff) energy can be calculated. (auth)

19258 (ORNL-3583) A NOTE ON IMPORTANCE FUNCTIONS FOR THE SHIELDING OF MANNED SPACE VEHICLES. R. G. Alsmiller, Jr. (Oak Ridge National Lab., Tenn.). Mar. 1964. Contract W-7405-eng-26. 29p.

The tissue dose calculations of Kinney were used to calculate several importance functions associated with the dose from primary and secondary particles in the tissue due to penetration of an aluminum shield by a solar-flare proton spectrum. Secondary particles produced in the shield were not considered. (auth)

19259 (USNRDL-TR-707) SOME GAMMA-RAY SHIELDING PROPERTIES OF FINITE STEEL SLABS. G. E. Langer and B. W. Shumway (Naval Radiological Defense Lab., San Francisco). Jan. 21, 1964. 48p. (AD-433658)

Some gamma shielding properties of plane steel slabs placed between a point source and a point detector were investigated. The dose buildup (B_r-1) resulting from 8 by 9 ft slabs 0.25, 1.00, and 1.50 in. thick (0.36, 1.45, and 2.17 mean free paths) placed between a Cs^{137} point source and a small hemispherical ionization chamber was measured. The distance from the source to the detector was 16 ft. Each slab was placed at five selected points between the source and the detector in order to observe the variation in B_r-1 with slab position. The dose buildup due solely to singly scattered photons was calculated both for the 8 by 9 ft slabs and for slabs of infinite extent. The measured values of dose buildup are compared with the calculations. A similar set of measurements was made for 1.25-Mev photons incident upon steel slabs 0.25 and 0.75 in. thick (0.26 and 0.78 mean free paths). The distance from the source to the detector was 25 ft for these measurements. The effect of interchanging two separated slabs of different thicknesses was measured for two slab pairs; one 0.25 and 0.75 in. thick, the other 0.50 and 1.00 in thick. Dose buildup due to separated slab pairs was measured. It was also estimated from single slab data, and the results were compared. (auth)

19260 THE EFFECT OF THE WATER CONTENT OF CONCRETES ON THE THICKNESS AND COST OF REACTOR SHIELDS. D. L. Broder, L. N. Zaitsev, B. S. Sychev, and A. M. Tugolukov. At. Energ. (USSR), 16: 26-32(Jan. 1964). (In Russian)

The density and the water content of concretes used for shielding affect markedly the weight of the reactor shield and thus influence the cost of the nuclear-generated electricity. Among other factors, the bound water depends on the type of cement and filler used, the setting time, and the temperature. The presence of H has a beneficial effect because it reduces the intensity of the capture γ radiation. However, concrete with a high water content is more expensive and therefore an attempt was made to determine the most economical composition. The tests were carried out by placing plane, isotropic neutron and γ sources on the steel housing of the concrete shield of a graphite-moderated, -reflected reactor. Forty-six different types of concrete, with densities ranging from 2300 to 5200 kg/m^3 and H contents from 0.10 to 0.65 wt. % were tested. It was found that when the density is increased to the maximum while keeping the water content constant, the contribution of the γ radiation to the total radiation beyond the shield decreases from 99.9 to 5.4%. Increase of the water content is especially effective in the case of heavy concretes. The optimum amount of water for a given attenuation depends on the thickness yielding the least expensive biological shield. Shields made of ordinary 2300 kg/m^3 concrete were found to be least expensive, when containing 80 kg/m^3 of bound water, corresponding to 0.35 wt. % of H. The cost of medium heavy concretes was at minimum at their lowest water content; that of the heaviest concretes at the highest water content. (TTT)

19261 FAST PILE-NEUTRON SPECTRA AFTER PASSAGE THROUGH GRAPHITE, LEAD, AND IRON. A. P. Veselkin, Yu. A. Egorov, Yu. V. Orlov, and Yu. V. Pankrat'ev. At. Energ. (USSR), 16: 32-40(Jan. 1964). (In Russian)

Following up previous work by V. N. Avaev et al. (Atomnaya Energ. 15: 20(1963)), a fast-neutron scintillation spectrometer, provided with a H-containing sensor, was used for the determination of the fast-neutron spectrum of a water-cooled, water-moderated reactor within the 0.7- to 1.1-Mev range, after allowing the neutrons to pass through varying thicknesses of graphite, Pb, and Fe. Tests with a Co^{60} source indicated that the spectrometer used does not record γ radiation with a maximum energy of 1.33 Mev, if its dose rate does not exceed 15 microcurie/sec; in that case, the energy threshold of the instrument was 0.4 Mev. Using 22.5- and 45-cm thick graphite layers, the calculated and measured spectra agreed with each other within the limits of the experimental error. At $E_n <$ 4.5 Mev, the measured neutron fluxes exceeded the calculated ones by a factor of 2 to 3; the divergence was probably due to the geometry used in the experiments. Using layers thicker than 45 cm, maxima and minima were noted in the 3- to 7-Mev range; they were caused by the irregularities in the energy dependence of the total interaction cross section of the neutrons with the nuclei. From the spectral distribution, the fast-neutron attenuation in the various energy ranges was calculated together with the stripping cross section the the relaxation length. The data obtained may be used for reactor shielding calculations. (TTT)

19262 A METAL–WATER SHIELD FOR POINT NEUTRON SOURCES. O. A. Barsukov and V. S. Avzyanov. At. Energ. (USSR), 16: 40-8(Jan. 1964). (In Russian)

In order to determine the best shield design, a point source was placed in the center of a metal–water medium and an attempt was made to select the arrangement of layers which yielded the best results in slowing down and absorbing the neutrons and the γ radiation while keeping the dimensions and the weight of the shield to a minimum. The scattering was taken into consideration by using the multigroup diffusion approximation of the Boltzmann equation. A 10^8 n/sec Po–Be point source placed in the center of a 30-cm radius sphere was used in the experiments. The changes in the energy spectrum of the emitted neutrons in a homogeneous, water or Fe, medium were determined. The Fe medium was found to cause a considerable softening of the spectrum; in the case of water, the 10.8- to 1-Mev neutrons became the chief component of the energy spectrum. The water also slowed down effectively the neutrons with lower energies. The results indicated that it is desirable to use a complex system, consisting of hydrogenous materials such as water or paraffin and a metal, e.g., Fe, Cu, or Pb. The shielding properties of the two-layer Fe–water system were found to be superior to those of a homogeneous water system if the total thickness of 1 of the 2 layers is larger than the inversion length 1_{inv} (25 cm). However, in the 3- to 1-Mev range in which the inelastic scattering cross section of the Fe is small and the elastic scattering cross section is still smaller, the neutrons of that energy range may be accumulated. An improved shielded container was designed on the basis of the data obtained. (TTT)

19263 THE SPECTRUM MATRIX METHOD IN γ RAY TRANSMISSION PROBLEMS FOR MULTIPLE LAYERS. Akira Tsuruo (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 6: 91-7(Feb. 1964). (In Japanese)

An approximate calculation method in γ transmission problems is shown for multiple layers. In this method, the differential energy flux of incident γ rays is expressed by a vector, and the shielding property of each slab is represented by a matrix. The matrix is constructed by a relatively simple procedure, using the data of penetration in infinite media calculated by the moments method and the data of the effect of finite slabs calculated by the Monte Carlo method. The compound shielding property of multi-

ple layers is also represented by the matrix, which is obtained by the multiplication of the matrix corresponding to each slab. The differential energy flux of transmitted γ ray is given by multiplying the incident vector by the matrix. The results of the method were compared with those of the Monte Carlo calculation for $Pb-H_2O$ and H_2O-Pb stratified slabs, and also with those of experiments for Pb, Fe, and Al stratified slabs. The comparison showed that this method is useful for all combinations of materials for high incident energy, and when low energy γ rays enter the heavy layer followed by a light or heavy layer. (auth)

19264 DENSE LITHIUM FLUORIDE FOR GAMMA-RAY-FREE NEUTRON SHIELDING. V. D. Svikis (Dept. of Mines and Technical Surveys, Ottawa). Nucl. Instr. Methods, 25: 93-105(Dec. 1963).

A simple method of processing powdered LiF into dense and strong LiF, suitable for self-supporting neutron shielding, was developed. The processing was carried out in two stages. In the first stage, chemically pure LiF powder was slip-cast and sintered for 1 to 5 hours at temperatures from 500 to 840°C, in order to establish the best conditions for making dense and volume-stable LiF aggregate. Aggregates were prepared with densities in the range 52 to 92% of theoretical, depending on sintering temperature and time. Maximum density was achieved by sintering at 700°C for 3 hours. In the second stage, dense and stabilized LiF aggregate was graded, pressed into shapes at 4000, 6000, and 8000 psi, and heated at 600 and 800°C to find the best conditions for making dense compacts. LiF compacts, as large as $8\frac{3}{4}$ by $4\frac{1}{2}$ by 3 in., with densities in the range 78 to 85% of theoretical, were prepared. Maximum density and good mechanical strength were attained when the graded aggregate was pressed into shapes at a pressure of 8000 psi and the shapes were heated for five hours at 800°C. The material can be cut and machined to close, dimensional tolerances. (auth)

19265 PROBLEMS IN RADIATION SHIELDING OF SPACE VEHICLES. J. Warren Keller, Russell D. Shelton, Martin O. Burrell, and James A. Downey, III. (George C. Marshall Space Flight Center, Huntsville, Ala.). p.241-60 of "Astronautical Engineering and Science." New York, McGraw-Hill Book Co., Inc., 1963.

The minimum-weight shielding problems for manned space vehicles are described. Nuclear fission sources and interplanetary sources of radiation are considered. 16 references. (R.E.U.)

REACTOR TECHNOLOGY

General

19266 (CRRP-1184) PERIGEE COMPUTER CODES FOR REACTOR SIMULATION IN 3 DIMENSIONS, USING 1 OR 2 NEUTRON VELOCITY GROUPS. A. P. Olson (Atomic Energy of Canada Ltd., Chalk River, Ont.). Feb. 1964. 107p. (AECL-1901)

Includes Appendices A and B.

The PERIGEE program, in SNAP for the G-20 computer, solves the one- or two-group neutron diffusion equations by finite-difference methods on a three-dimensional, uniform mesh having a common spacing in the two directions normal to the fuel channels. The positions of mesh points along a fuel channel, relative to points in adjacent channels, may correspond to either NPD or CANDU fuel bundle positions. The extrapolated flux boundary may be specified in sufficient detail to represent a tapered or stepped circumferential reflector, a variable axial length and, for a reactor with axis horizontal, a variable moderator level and a variable plane bottom surface equivalent to the CANDU dump structure. The neutron flux may be normalized to give a specified power output from the hottest fuel bundle or hottest channel, or to give a total thermal power limited by the turbine and generator. Reactor operation may be simulated in finite time steps, taking into account any fuel shifts, any changes in moderator level and the change in nuclear properties of the fuel with increasing irradiation. The appropriate properties are obtained by interpolation from tables supplied for as many as 8 types of fuel bundle. The mean fuel exit burnup can be calculated at equilibrium for a reactor in which the exit burnups for two zones may be adjusted to give radial power flattening and the fuelling schedules may be designed to give axial power flattening in one or both zones. (auth)

19267 (DP-829) CONTAMINATION AND DECONTAMINATION OF LOW TEMPERATURE, WATER-COOLED REACTORS. PART IV. DEPOSITION OF RADIONUCLIDES FROM REACTOR COOLANT. Anton B. Carlson (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Nov. 1963. Contract AT(07-2)-1. 52p.

The deposition of radioactivity from coolant on stainless steel and aluminum in the production reactors at the Savannah River Plant was investigated at exposure temperatures of 30 and 85°C. Data from decontamination tests were used to aid in developing the mechanisms of deposition. The buildup of activity on stainless steel was associated with the deposition of a crud film that was comprised principally of alumina. The buildup of activity on aluminum was associated with the in situ development of the corrosion film on the metal surface and, therefore, was related to the corrosion rate of aluminum. (auth)

19268 (EURAEC-873) HEAT TRANSFER AND STABILITY STUDIES IN BOILING WATER REACTORS. Quarterly Progress Report No. 11, July 1, 1963–October 1, 1963. (Eindhoven, Netherlands. Technische Hogeschool). Work Performed under United States–Euratom Joint Research and Development Program. Contract 032-60-11-RDH. 73p.

Series X with the 50 mm shroud was completed. The analysis is underway and will appear as a special report. The problem of fluctuations in the power was solved by changing the feed back. The signal of the pressure gage was recorded on magnetic tape at various temperatures. These signals were analyzed digitally. Auto-correlations and power spectra were calculated. A series of measurements (XI) with a 50 mm shroud instrumented with 5 impedance void gages was carried out. Difficulties were encountered due to a lack of stiffness of the shroud. Nevertheless the impedance void gages worked well and recordings were made of the void signals. Series XII with a 70 mm shroud was started. It appeared impossible to carry out a reliable series of measurements owing to severe fluctuations in waterlevel and absolute pressure with a period of 40 sec. Efforts were made to avoid these oscillations but without satisfactory results. The results obtained from calculations using the theoretical model describing the steady state behavior were partly analyzed. (auth)

19269 (EURAEC-924) DEVELOPMENT PROGRAM ON THE APPLICATION OF STEAM-WATER SPRAY TO REACTOR COOLING. CAN-3 Quarterly Progress Report No. 8, October 1–December 31, 1963. (Centro Informazioni Studi Esperienze, Milan). Jan. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 056-62-1-RDI. 15p. (CISE-R-95)

During the period, heat transfer experiments in the large scale Genova loop were pursued. The phase distribution measurements performed with the extraction probe in a tube with a circular cross section were finished. Critical heat flux and pressure drop measurements were performed on a 400 cm long test element (1.5 cm I.D.) to extend the range of heated length, study of the effect of an inlet pressure drop, check the influence of pressure, and determine the effects of obstacles in the duct. The design of annular and cluster elements is completed and their construction is in progress. A technical report, concerning critical heat flux and pressure drop measurements in round vertical tubes at the pressure of 51 kg/cm^2 abs, was issued. At the end of the period the in-pile corrosion experiments can be considered finished; at that time about 1700 hours of exposure will be reached. The informations on water chemistry (production of gases, variations of water pH and resistivity, etc.) collected during the active corrosion runs and cooling periods will be used as background for the water chemistry and radiolysis experiments to be done in the next quarter. The third static corrosion test (285°C–70 kg/cm^2) was carried on, and many analyses of corrosion products, collected on filters and resins during loop operations, were accomplished. (auth)

19270 (HW-77221) CLUMSY I—A TIME- AND SPACE-DEPENDENT REACTOR KINETICS CODE FOR THE IBM-7090 COMPUTER. R. E. Tiller and C. A. Oster (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 1, 1963. Contract AT(45-1)-1350. 111p.

A reactor kinetics code, CLUMSY I, which will solve for the neutron flux and associated parameters of interest (such as fuel and coolant temperatures) as a function of time and space has been programmed for the IBM-7090 digital computer. The spatial dependence is limited to one dimension, x, y, or z for cartesian coordinates, and r for cylindrical coordinates. The calculation of the neutron flux level includes the effect of the delayed neutrons and the reactivity effects of fuel and coolant temperature changes. Provisions

have been made in the program so that arbitrary space and time dependent reactivity changes (such as the safety system insertion) can be specified, in tabular form, in the input data. The heat transfer model assumed is exceedingly simple, and no allowance has been made for the calculation of temperatures under conditions of two-phase coolant flow. (auth)

19271 (IDO-16948) SHUTDOWN REACTIVITY BY THE MODIFIED ROD DROP METHOD. K. V. Moore (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 10, 1964. Contract AT(10-1)-205. 19p.

A more accurate rod-drop method for measuring the shutdown reactivity available from control rods is outlined. Corrections due to flux shape changes can be applied to the measurements, and the use of pretimed scram equipment provides excellent reproducibility. Finite rod-drop times are also taken into account. Results for ARMF-II and ETRC are included. (auth)

19272 SAFETY COEFFICIENTS IN NUCLEAR REACTORS: THE HOT-SPOT FACTORS. Maurizio Cumo and Roberto Evangelisti. Calore, 34: 293-303(July 1963). (In Italian)

The nuclear and engineering hot-spot factors are defined, and their equations are derived. These equations are then applied to specific reactor types as an example. The statistical definitions and relative criteria for evaluation are given. (J.S.R.)

19273 REPORT ON THE REACTOR SIMULATOR TESTING AND ITS IMPROVEMENT. Hirotake Kuma (Kyusyu Electric Power Co., Inc., Japan). Kenkyukiho, 19: No. 1, 8-17(May 1963). (In Japanese)

Fundamental analyses of reactor transient characteristics were carried out using a reactor simulator. Transient power changes of reactors subject to positive step reactivity ($l = 10^{-4}$ sec., $\beta = 0.0064$; $\rho = 0.002$; β = const.; and $\rho = 0.002$, l = const.), to negative step reactivity ($\rho = -0.002, -0.004, -0.008$), and to positive ramp reactivity ($\rho = 0.0002$/sec., 0.0004, 0.0006, 0.001, 0.002) were analyzed. The results agreed approximately with theory. The effects of Xe accumulation on power change were determined: equilibrium values of the poisoning effect of Xe were parallel to the accumulation values of Xe after 5 hrs from reactor start up ($\phi = 10^{12}$ n/cm^2 sec, 10^{13}, 10^{14}, and $\Sigma f/\Sigma a = 0.692, 0.802$); build-up of Xe after shut down of the reactor was $\phi = 10^{12}$ n/cm^2 sec, 10^{13}, 5×10^{13} and $\Sigma f/\Sigma a = 0.692, 0.802$; the variation of Xe poisoning with power change was $Zf/\Sigma a = 0.692$ and $\phi = 2 \times 10^{13}$ n/cm^2 sec, 4×10^{13}, 6×10^{13}. Minimum Xe poisoning obtained was about 0.025 in each case. The shut down effects of high-neutron-flux scram and reactor period short scram (both $\beta = 0.0064$, $l = 10^{-4}$ sec, $\rho = -0.008$) are simulated. A dynamic analysis was performed on transient change of reactor power subject to step-reactivity insertion ($l = 10^{-3}$ sec, $\beta = 0.0074$, $\Delta\rho/\Delta TW = -5.4 \times 10^{-4}(\Delta\rho/°C)$, ρ variable; and $\Delta\rho = 0.008$, $\Delta\rho/\Delta TW$ variable) by incorporating a feed-back circuit of simple negative temperature coefficient in the reactor simulator. It was found that damped oscillation occurred in the reactor power, which settled at a stable level when the negative temperature coefficient was large. The tests achieved some improvement in the mechanism and parts of the simulator. (from NSA of Japan)

19274 A REPORT ON SECTION III OF THE ASME BOILER AND PRESSURE VESSEL CODE: RULES FOR CONSTRUCTION OF NUCLEAR VESSELS. E. O. Bergman (National Engineering Science Co., Pasadena, Calif.). Mater. Res. Std., 4: 175-6(Apr. 1964).

Section III of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code: Rules for Construction of Nuclear Vessels is discussed. The history, membership, and policy of the Special Committee on Nuclear Power of the ASME, which drew up the rules, are described. The new code divides nuclear vessels into three classes: Class A vessels, which form part of the reactor coolant system, Class B vessels, which are containment vessels, and Class C vessels, which are all other vessels. Special requirements for inspection of Class A vessels are discussed in some detail. (auth)

19275 THE S_4 AND FEW-GROUP DIFFUSION CALCULATIONS OF FAST REACTORS. Masao Ota and Hiroshi Nishihara (Kyoto Univ.). Mem. Fac. Eng. Kyoto Univ., 25: 273-86(July 1963).

To eliminate a large amount of numerical work in the calculation of fast breeders, the possibility that few-group diffusion theory might give acceptable results in some cases was investigated. A hypothetical $^{233}U-^{232}Th$ system with large core size (~670 l) and a hypothetical $^{239}Pu-^{238}U$ fast reactor with small core size (~50 l) are adopted. These systems are assumed to be of spherically symmetric geometry. One-dimensional calculations are applied to obtain the static characteristics of the systems. The results from few-group S_4 and diffusion methods seem to indicate that 4- or 3-group diffusion calculations might be used in place of 3-group S_4 computations for both large and small fast reactors. A new convergence criterion imposed upon the static parameters is proposed. The leakage rate of neutrons from the blanket is selected as the sensitive measure of convergence. This rate is estimated in 2 ways, with the aid of neutron current and by neutron inventory. A sufficiently converged state is reached when these 2 values coincide. The necessary number of spatial mesh points may also be inferred by comparing these 2 values. (from NSA of Japan)

19276 CALCULATION OF IN-PILE NEUTRON SCATTERING ANISOTROPY WITH A MAGNETIZED FERROMAGNETIC SLAB. Ryozo Aoki (Tokyo Univ.). Nippon Genshiryoku Gakkaishi, 6: 81-90(Feb. 1964). (In Japanese)

A trial calculation was made to get an instantaneous and direct control mechanism for the reactor neutron reactivity. When a neutron is incident on a slab of fine grained ferromagnetic material, the angular distribution of the scattering intensity depends on the angle between the magnetization vector and the incident direction. An expression is given for the difference in the forward scattering intensity when the saturation magnetization vector is varied from parallel to perpendicular to the slab axis. (auth)

19277 TECHNOLOGIE DES REACTEURS NUCLEAIRES. TOME II. REACTEURS NUCLEAIRES A URANIUM NATUREL, GRAPHITE ET GAZ. (Technology of Nuclear Reactors. Volume II. Nuclear Reactors of Natural Uranium, Graphite, and Gas). Thomas Reis. Paris, Editions Eyrolles and Paris, Editions Gauthier-Villars, 1963. 416p.

A collection is presented of the technologies of 234 worldwide natural-uranium, graphite-moderated, gas-cooled reactors. Experimental, power, and production reactors are discussed. Comparisons of reactor materials and their compatibility are presented. Numerous references are given. (R.E.U.)

Auxiliaries and Components

Refer also to abstracts 17775 and 17776.

19278 (LADC-6263) ANALYTIC SOLUTIONS FOR THE WORTH OF A RING OF CONTROL RODS IN A

MULTI-REGION CYLINDRICAL REACTOR. B. M. Carmichael (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 5p. (CONF-446-1)

For Presentation at the American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

The solution for the worth in the multi-region case is outlined. The results obtained with the analytic method compare favorably with those obtained using numerical techniques. (D.C.W.)

19279 (NAA-SR-Memo-9458) A STUDY OF THE APPLICABILITY OF THE DTK CODE TO THE CALCULATION OF THE THERMAL NEUTRON FLUX IN A REACTOR SHIELD. D. E. Lamkin and V. Keshishian (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 27, 1964. Contract AT-11-1-GEN-8. 21p.

It was found that the DTK code does not compute the magnitude of the thermal neutron flux accurately at deep shield penetrations. However, the calculated neutron spectrum was observed to be fairly accurate. The thermal neutron flux in two shields was estimated quite accurately by using the DTK spectra in conjunction with fast removal theory to determine the magnitude of the fast flux. (auth)

19280 (ORNL-3580) DESIGN AND CONSTRUCTION OF EDDY-CURRENT COOLANT-CHANNEL SPACING-PROBES. C. V. Dodd (Oak Ridge National Lab., Tenn.). Apr. 1964. Contract W-7405-eng-26. 23p.

The coolant-channel spacing between two flat fuel plates may be measured using an eddy-current induction coil. The range and sensitivity of these spacing measurements are functions of the coil geometry, the material surrounding the coil, and the operating frequency. Experimental curves are given showing how the coil impedance varies as a function of geometry, frequency, and the material surrounding the coil. A design problem is solved showing the compromises made between range and sensitivity which determine the coil geometry. The wire size and hence the proper number of turns are selected to match the coil to an alternating current bridge. Probe construction techniques are given to help the user construct both the coil and the apparatus to position the coil in the coolant channel. The necessary data for the design of spacing probes for many similar problems are given. (auth)

19281 (WAPD-TM-360) A FORTRAN CODE FOR CALCULATING THE EFFECT OF FISSION AND DECAY HEAT ON TEMPERATURE DISTRIBUTION ACROSS CYLINDRICAL FUEL RODS IN VARIOUS COOLING CONDITIONS. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Jan. 1963. Contract AT-11-1-GEN-14. 47p.

The equations needed to evaluate fuel-rod temperatures are presented; and the program M0304 written to evaluate the fuel and cladding temperatures of any type of fuel rod (with known thermal properties) in either forced or natural convection and radiation cooling conditions, is described. Results are included. (D.C.W.)

19282 THEORY AND PRACTICE OF DETERMINING LEAK RATES OF REACTOR SAFETY CONTAINMENTS. [PART] II. H. M. Becker and H. J. Wagener. Atomwirtschaft, 9: 66-8(Feb. 1964). (In German)

A measuring process was developed for determining leak rates in reactor containment vessels in which a metal wire is used as a resistance thermometer. Because of the difficulties accompanying the use of a free, stretched wire in a large container, a hemp rope was used as a carrier for the wire which was laid between the strands. The theory and practice of this process are described in terms of the practical example provided by the tightness testing of the reactor chamber of the DIDO reactor (FRJ-2) in the Jülich Nuclear Research Centre. The method had the expected advantages in addition to an improvement in the accuracy of measurement. It proved possible to construct the measuring arrangement and mount the cable in about three hours. The investigation described occupied only 2 to 3 workers for 24 hours and, compared with similar tightness tests on reactor chambers performed using other arrangements, led to a considerable lowering of costs. After the experiment the calibration of the cable was again checked without any change of resistance or of temperature coefficient being detectable within the limits of measurement. (auth)

19283 SODIUM-COOLED REACTORS: THE TECHNOLOGY OF SODIUM AS COOLANT. William J. Hallett. Ind. At., 7: Nos. 11-12, 63-75(1963). (In French)

The properties of sodium as a high temperature reactor coolant are reviewed. Investigations in progress to minimize the effects of sodium and potassium reactions with air and water are described. The performance of pumps, valves, and instruments used with liquid metals is evaluated for operating sodium reactors. (P.C.H.)

19284 CEGB NUCLEAR TEST LOOP. I. Owen (Berkeley Nuclear Labs., Gloucestershire, Eng.). Nucl. Eng., 9: 27-9(Jan. 1964).

An experimental gas loop designed to investigate the heat transfer performance of fuel elements is described. (C.E.S.)

19285 A SIMPLE DETECTOR FOR THE MEASUREMENT OF ROOM-SCATTERED NEUTRONS. E. V. Weinstock and J. P. Phelps (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 18: 525-8(Apr. 1964). (BNL-7412)

A detector is described for measuring the neutron flux that has escaped from an assembly and returned to it as a result of scattering from some massive object near the assembly. The detector has 2π-directional sense for discriminating between neutrons leaving the assembly and those returning. (C.E.S.)

19286 CRITERIA OF SECTION III OF THE ASME BOILER AND PRESSURE VESSEL CODE FOR NUCLEAR VESSELS. New York, The American Society of Mechanical Engineers, 1964. 22p.

Requirements associated with stress categories and stress limits, fatigue analysis, creep and stress-rupture, fabrication and inspection, and materials of construction are described as developed by members of ASME. (R.E.U.)

19287 RULES FOR CONSTRUCTION OF NUCLEAR VESSELS. ASME Boiler and Pressure Vessel Code Section III. Report of Subcommittee of Boiler and Pressure Vessel Committee. New York, The American Society of Mechanical Engineers, 1964. 143p.

Topics included in the 1963 edition of Section III, Nuclear Vessels are materials, design, fabrication, inspection, testing, and marking and stamping for class A, class B, and class C vessels. Stress analysis methods are discussed. (R.E.U.)

19288 HYDRAULIC CONTROL ROD DRIVE (Engineering Materials). (American Bosch Arma Corp. American Bosch Div., Springfield, Mass.). (CAPE-1065)

Six photographs and 383 drawings are included. The hydraulically operated control and actuator is used in pressurized-water and boiling-water nuclear reactors. Primary reactor water is used to operate the mechanism, and this section is completely sealed within the pressure vessel for

zero leakage. Signals to the control sleeves and the feedback signals of control rod position are transmitted through the pressure vessel wall by means of a magnetic-field coupling, which eliminates use of shaft sleeves. The actuator features a hydraulic feedback within the power unit that equalizes load and hydraulic forces. A change in the hydraulic force causes power piston motion that through the feedback coupling, actuates the servo piston. The position of the control rod within the pressure vessel is transmitted by means of a digital readout system. (F.S.)

19289 IMPROVEMENTS IN OR RELATING TO CABLE WINDING APPARATUS. Frederick William Friars and John Duncan Mackenzie Brown (to United Kingdom Atomic Energy Authority). British Patent 953,232. Mar. 25, 1964. Filed July 10, 1961.

A winding apparatus is designed for removing radioactive thermocouples from a gas-cooled reactor without hazard to the operator. The apparatus has shielding means, and two embodiments are described: one for cutting and withdrawing a cable from a channel, and one for conducting the withdrawing operation only. (D.L.C.)

19290 IMPROVEMENTS IN OR RELATING TO CABLE CUTTING DEVICES. Frederick William Friars and Robert Walker Bolling (to United Kingdom Atomic Energy Authority). British Patent 953,233. Mar. 25, 1964. Filed July 10, 1961.

A remotely operable device is designed for cutting thermocouple cables for removal from channels of gas-cooled reactors. The device is threaded on the cable and lowered into the channel until it contacts the end fitting on a fuel element, and gas pressure is used to actuate the shearing means. The device is then withdrawn with the clamped cut cable by means of a shielded winch unit described in British Patent 953,232. (D.L.C.)

19291 HANDLING MACHINE FOR A NUCLEAR REACTOR. Georges Lemesle, Roger Martin, Marcel Monteil, Roland Roche, and Pierre Rouge (to Commissariat à l'Energie Atomique). British Patent 953,297. Mar. 25, 1964. Priority date, Feb. 20, 1962, France.

A fuel handling machine for gas-cooled reactors is designed which overcomes the operating difficulties of rotatable magazines. The machine comprises a magazine, a handling unit, means on the unit for locking the magazine in a fixed predetermined position, prehensile means on the unit engageable with the fuel elements, and means for displacing the prehensile means relative to the locked magazine. The machine is to be used in conjunction with an apparatus described in British Patent 953,298. (D.L.C.)

19292 NUCLEAR REACTOR FUELLING ARRANGEMENT. Georges Lemesle, Roger Martin, Marcel Monteil, Roland Roche, and Pierre Rouge (to Commissariat à l'Energie Atomique). British Patent 953,298. Mar. 25, 1964. Priority date Feb. 20, 1962, France.

A reactor fueling arrangement is designed for gas-cooled reactors. The design and operation of the arrangement is described in detail. The fuel handling machine is described in British Patent 953,297. (D.L.C.)

19293 IMPROVEMENTS IN OR RELATING TO CONTROL SYSTEMS FOR NUCLEAR REACTORS. Donald Harrison (to United Kingdom Atomic Energy Authority). British Patent 953,383. Mar. 25, 1964. Filed Jan. 17, 1961.

A control system for obtaining a trip signal for reactor shutdown in response to excess neutron flux, is designed in which the risk of spurious trip signals is reduced to a minimum. The control system includes an ionization chamber, an a-c generator for providing polarizing potentials for the chamber, an integrator for receiving the chamber output, means for feeding to the integrator current components which cancel out the normal in-phase component of the chamber output and produce a residual signal from the quadrature components, means for sampling the integrator output at electrical angle intervals, and means for causing a control element to trigger in response to the integrated in-phase component. The operation of the control system is discussed in detail, and the reasons for its good fail-safe characteristics are outlined. (D.L.C.)

19294 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Ronald Hugh Campbell (to United Kingdom Atomic Energy Authority). British Patent 953,534. Mar. 25, 1964. Filed Nov. 9, 1959.

An automatic control system is designed which obtains an electromechanical phase advance without the use of large capacitors, high impedance circuits, and d-c amplifiers. The system comprises a control loop for moving a reactivity control rod in response to a temperature measured in the reactor, a first feedback loop with input from the control rod movement and feeding it back negatively to the control rod drive, and a second feedback loop for reducing the first feedback loop signal, the gain of the first loop exceeding that of the second loop. (D.L.C.)

19295 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTORS. Roderick Taylor (to Nuclear Power Plant Co. Ltd.). British Patent 953,650. Mar. 25, 1964. Filed Sept. 29, 1959.

A solid moderator core structure is designed for gas-cooled graphite-moderated reactors. The structure comprises an assembly of spaced vertical columns of graphite blocks within a constrained framework. The columns are divided into static columns and dynamic columns in which clocks can move vertically. The columns are arranged so that each dynamic column is surrounded by four static columns and vice versa, and wedges are provided between the columns, with their inclined plane surfaces in sliding contact with similarly inclined plane surfaces in the dynamic column block ends and their vertical plane in sliding contact with the static column sides. The structure can be keyed solidly to the supporting base plate while providing compensation for irradiation growth or shrinkage and differential thermal expansion. (D.L.C.)

19296 DETECTION OF FAULTY FUEL ELEMENTS IN REFUELLING MACHINES ON NUCLEAR REACTORS. Ernest Basil Page (to Plessy Co. Ltd.). British Patent 953,694. Mar. 25, 1964. Filed June 24, 1959.

A method is given for testing a fuel element in the fueling machine either before insertion into the reactor or after withdrawal from the reactor. The method comprises isolating the element for a brief time, depressurizing the element to induce escape of fission products, and detecting the fission products. Thus, defects and punctures in sheaths may be detected and, more important, the depressurizing treatment induces incipient faults in the cans or welds to fail and be detected. Two embodiments of an apparatus for carrying out the method are described, one for use in a storage magazine chamber and the other for use above the chamber. (D.L.C.)

19297 IMPROVEMENTS RELATING TO ROTATIONAL DRIVE COUPLINGS. Dennis Surridge Morfey (to Associated Electrical Industries Ltd.). British Patent 953,912. Apr. 2, 1964. Filed July 9, 1959.

A rotational drive coupling is designed for manually raising and lowering a control rod in a reactor when the

electrical motor is not operative. The coupling prevents the rod from falling under gravity while permitting the rod to be moved freely either up or down. The coupling comprises a driving member and an axially aligned driven member biased by a load, a positive coupling with lost motion between the driving and driven members, a helical spring encircling the members, and a fixed braking sleeve around the spring. In operation, the bias in the driven member tends to expand the spring to lock against the sleeve, while rotation of the driving member drives the driven member directly through the positive coupling and releases the spring from the sleeve. (D.L.C.)

19298 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Peter Munro Boocock and Frank Geoffrey Johnson (to United Kingdom Atomic Energy Authority). British Patent 954,101. Apr. 2, 1964. Filed Nov. 28, 1961.

A control arrangement for a steam-generating and superheating reactor is described which consists in supplying and withdrawing heavy water moderator to and from tubes in the reactor core. The tubes have enlarged sections within the center of the core, and one of them may have a short enlarged section for "fine" control. The heavy water level in the tubes is controlled by helium pressure, and the circuits and associated equipment are described. The control arrangement may be used to modify the flux distribution in the core. (D.L.C.)

19299 CHANNEL PLUG FOR NUCLEAR REACTOR. Didier Costes (to Commissariat à l'Energie Atomique). British Patent 954,144. Apr. 2, 1964. Priority date Aug. 16, 1961, France.

A channel plug is designed which is impervious to fluids, can be manipulated by fueling machines, and will not allow incorrect operations, that is, it is adapted for removal only when the fueling machine is fitted properly to the channel. The plug comprises a plug body, one set of latching members for connection to the channel wall, another set of latching members for connection to the conveyor element of a fueling machine, and a control element with cam means for operating the latching members. (D.L.C.)

19300 IMPROVEMENTS RELATING TO NUCLEAR REACTOR HEAT EXCHANGER UNITS. (to Babcock and Wilcox Co.). French Patent 1,297,494. May 21, 1962. Priority date Aug. 22, 1960, United States.

A nuclear reactor installation where the reactor core and the heat exchangers are enclosed in the same pressure vessel was considered. The pressure vessel had a cylindrical shape and was provided with an inner deflector cylinder spaced from the pressure vessel wall, such as to form a path for an upward flow of coolant within the deflector cylinder and a path for a downward flow in the annular interspace between the deflector and the pressure vessel wall. The two flow paths were connected at their upper and lower ends in order to form a closed circuit for natural circulation. The reactor core was suspended within and by the lowest section of the deflector cylinder. The deflector cylinder is suspended at an upper section of the pressure vessel at the level of the vessel access hole to allow the removal of the unit deflector cylinder-reactor core. The heat exchangers are disposed within an upper region of the interspace between deflector and pressure vessel wall and are suitably constituted by vertical tube bundles each provided with entrance and exit headers for the working fluid. The headers are suitably disposed so as to form plugs to close lateral openings in the pressure vessel wall. (IIB)

19301 LIQUID MODERATED NUCLEAR REACTOR. (to English Electric Co. Ltd.). French Patent 1,304,480. Aug. 13, 1962. Priority date Oct. 27, 1960, Great Britain.

For a liquid-moderated nuclear reactor an inlet device was designed to provide for the passage of at least one gas flow through at least one region of the liquid moderator in order to reduce the moderator density in the proximity of the gas flow, while an outlet device was designed to exhaust the gas from the reactor vessel. Preferably the inlet device comprises several tubes disposed at the bottom of the moderator vessel and in communication with the source of pressurized gas. For the injection of the gas the tubes are provided with openings into the vessel space, while the rising gas bubbles are collected at the top of the vessel in a space above the moderator level. According to another embodiment of the idea, the inlet device may be disposed within the reactor at an intermediary level, while a horizontal baffle-plate is placed at a certain distance under the moderator level in order to collect the gas and to guide it against an outlet tube, so as to produce at the bottom and at the top of the moderator space two regions, which are free from gas bubbles. (IIB)

19302 NUCLEAR REACTOR COOLED AND MODERATED BY AN ORGANIC LIQUID. (to United Kingdom Atomic Energy Ltd.). French Patent 1,305,294. Aug. 20, 1962. Priority date Nov. 22, 1960, Great Britain.

A nuclear reactor cooled and moderated by an organic liquid and which has two circuits for organic liquids having different percentages of high polymers is described. The first circuit with a liquid with a low percentage of such polymers comprises a passage through the reactor in the immediate proximity of the fuel elements while the second circuit, separated from the first one and working with a liquid with a high polymer percentage, is provided with throttling means in order to compensate for the pressure difference arising along the separating wall between the circuits. These throttling means are suitably constituted by baffle-plates. Preferably the percentages of high boiling polymers are 30 and 50% respectively. A distillation column is provided for controlling this percentage in the first circuit. (IIB)

19303 NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,305,300. Aug. 20, 1962. Priority date Nov. 23, 1960, Great Britain.

A nuclear reactor installation provided with several heat exchange circuits mounted in parallel is described. In order to avoid excessive coolant losses from the reactor vessel in case of a leak in a component of one of these circuits, these circuits, each comprising a heat exchanger and a circulating pump, are closed over the reactor vessel via inlet and outlet valves, which may be closed in order to shut off the damaged circuit. The closure of these valves is controlled by an instrument measuring the fluid flow in each outlet duct of the reactor vessel at a small distance downstream from the outlet valve, so that an excessive fluid flow in the duct induces automatically the closure of the corresponding outlet and inlet valves. (IIB)

19304 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to Société Belge pour l'Industrie Nucléaire "Belgonucléaire"). French Patent 1,315,685. Dec. 10, 1962. Priority date Mar. 9, 1961, Belgium.

A shut-down rod for a nuclear reactor controlled by the difference of pressures normally present within the reactor pressure vessel is described. Preferably this shut-down rod has a tubular shape and is adapted to slide within a vertical reactor channel so that in the case of danger, it may be projected by a spring and by gravity from a re-

tracted position outside the core to a position inside the core. A telescopic unit is provided in order to bring the rod back into the original position. It is disposed within the control rod, the lower end of the inner tube of which is provided with means to couple with the lower end of the rod. The tubes slide in a fluid-tight way on each other and on an inner and an outer guiding tube. The movement of the telescopic unit is controlled by the difference of pressures present above and under this unit. The coupling means are also controlled by pressure differences acting on bellows. (IIB)

19305 DEVICE FOR DISSIPATING THE ENERGY OF A FALLING BODY IN A NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,320,454. Jan. 28, 1963. Priority date Apr. 25, 1961, Great Britain.

Devices for dissipating the energy of a falling body (fuel element or control rod) within vertical reactor channels are discussed. If there is a rising coolant flow within the channel, it may be necessary to lock the device in the reactor channel. A device was designed with locking means which lock with the reactor structure only by elastic deformation while unlocking is performed by a plastic deformation of the locking means. It may consist of a tubular piece adapted to be deformed by the falling body in order to dissipate the kinetic energy of the latter and an annular support resting on an annular shoulder fixed to the lower extremity of the reactor channel. On the annular support a series of hook-shaped stainless steel bands adapted to engage the shoulder are mounted. For locking, the device is lowered until the hooks touch the shoulder and then lowered further urging the hooks to deform elastically against the axis of the device until they may engage the shoulder. For removal an appropriate handling tool is coupled with the device. By applying sufficient traction on the tool the hooks are submitted to a plastic deformation until the device may freely be removed from the channel. (IIB)

19306 CONTROL DEVICE FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,322,620. Feb. 18, 1963. Priority date May 17, 1961, Great Britain.

A control device for a nuclear reactor consisting of a control element adapted to be introduced into a vertical reactor channel was designed. A series of neutron absorbing annular discs were joined together to form a chain-like element adapted to be folded up. This element is disposed at the upper end of the reactor channel, so that it has a compact shape as the discs form a pile. A rod passing through the openings of the discs is provided at its lower end with means for retaining the lowest disc of the pile to retain the element in its compact shape. The rod is held in position by a breakable element and pushes at its upper end against a bellow. In case of a sudden pressure loss in the reactor the bellows expands and breaks the retaining element so that the rod falls down and releases the control element which unfolds itself downwards into the reactor channel. (IIB)

19307 PRESSURE VESSELS. Jack Jones Griffiths and Ronald Scott Challender (to United Kingdom Atomic Energy Authority). U. S. Patent 3,127,046. Mar. 31, 1964. Priority date July 16, 1959, Great Britain.

A reactor pressure vessel is designed with a strengthened access hole region in order to reduce the number of fuel channels per access hole. The vessel comprises a basic section of spherical form greater than a hemisphere, a cap section thicker and of greater curvature than the basic section, a small joining section between the basic and cap sections, and access holes penetrating the cap section. Some typical dimensions of such a vessel are given; for these dimensions, it can withstand working pressures up to 300 psi, as compared to 218 psi for a non-thickened cap section. (D.L.C.)

19308 CELL FOR VERTICAL CHANNEL NUCLEAR REACTOR. Jean Hainzelin, Leon Le Flem, and Jacques Robert (to Commissariat à l'Energie Atomique). U. S. Patent 3,127,320. Mar. 31, 1964. Priority date May 3, 1958, France.

A cell for liquid-moderated and -cooled reactors is designed for taking up a minimum of space while preventing stress and vibrations. The cell has an upper support which rests on a fixed member at the top of the reactor and a bottom member connected to the support by means of elastic linkages and centered in recesses in the base of the reactor. The embodiment of the cell that is described is designed for a heavy water reactor. (D.L.C.)

Crititicality Studies

Refer also to abstract 19336.

19309 (ANL-6725(p.201-23)) REACTOR SAFETY. (Argonne National Lab., Ill.).

The air oxidation of uranium at temperatures above 500°C is being investigated in order to determine the nature and degree of protectiveness of oxide films formed. Studies were performed with the following oxidants: pure oxygen at 500 and 600°C, dry air between 500 and 1000°C, and 20 vol % oxygen-80 vol % argon mixture between 500 and 1000°C. The results of these experiments were integrated with the results of previous studies of the uranium–air reaction in which a once-through flow method was used, and in which the oxygen and nitrogen depletion was measured by means of a mass spectrometer. The character of the oxidation reaction (linear, parabolic, or cubic rate law) found for a particular gas mixture and temperature was consistent; however, there was considerable scatter in the values of the rate constants and the times of transition from one reaction stage to another. The characteristics of the reaction of uranium with oxygen-containing gases suggested that the reaction rate is controlled by an adsorption equilibrium at the oxide-gas interface and by the diffusion of oxygen ions through oxide film. The transition from a parabolic to a linear reaction probably occurs when the protective oxide film begins to crack. Studies of the oxidation and ignition of plutonium are continuing. Results of ignition-temperature determinations with specimens of cubes and foils of pure plutonium indicated that the variation of ignition temperature with changes in specific area were not continuous. Ignition occurred at approximately 500°C for specimens of low specific area and at approximately 300°C for specimens of high specific area. The experimental program to determine rates of reaction of molten reactor fuel and cladding metals with water is continuing. A method of study is under development in which the energy contained in the light beam from a ruby laser heats single particles of metal in a water environment. Means are being developed of focusing the laser beam on metal particles contained within a glass reaction cell and measuring the efficiency of energy transfer. A rapid-response two-color optical pyrometer is being constructed to determine the temperatures reached by the heated particles. Microanalytical apparatus to determine the quantity of hydrogen generated by metal-water reaction in closed

glass reaction cells was constructed and tested. Studies of metal-water reactions initiated by a nuclear transient were continued. Small fuel specimens were submerged in water in high-pressure autoclaves, which were placed at the center of TREAT and subjected to severe nuclear transients. Four experiments were completed in water which was initially heated to 285°C (saturation pressure 1000 psi) prior to the reactor transients. The energy supplied in two transients was calculated to be only enough to melt the specimens. Only 0.2 to 0.4% metal-water reaction occurred in these runs, in agreement with results in room-temperature water. In the other two experiments, the nuclear energy input was calculated to bring the specimen temperature somewhat above 1200°C. The extents of metal-water reaction in these two tests were 76 and 89%, which was considerably greater than was observed for similar earlier runs in room-temperature water (<20% reaction). The reactions, however, did not generate an explosive pressure rise. Two TREAT experiments were performed, in each of which three SPERT-ID fuel specimens were arranged at the end of a long alumina tube. The metal-water reaction per gram of metal was identical with that obtained in previous experiments with single specimens. There was no indication that a violent water hammer was generated during the experiment such as that observed in the destructive transient recently conducted in the SPERT-1 reactor. Particle size determinations were performed on the residue from all of the TREAT experiments with the SPERT-ID and the SL-1 fuel material. The results showed that the surface area exposed to the water increased by a factor of about 100 when the nuclear energy input exceeded 450 and 530 cal/g for SPERT material and SL-1 material, respectively. The increased surface area coincided with an increase in the extent of metal-water reaction. A method was developed for comparing the quantity of metal-water reaction occurring in TREAT experiments with that estimated to have occurred in the SPERT-1 and SL-1 meltdowns. This procedure utilizes an estimate of the percentage of the reactor core that was completely melted and an estimate of the peak fission energy density at the center of the core. This information defined a sphere of melting in which the fission energy at the center of the sphere was a peak value (500 cal/g for SL-1 and 380 cal/g for SPERT-1) and the fission energy at the periphery of the sphere was 220 cal/g, the energy required to heat aluminum to its melting point and fully melt it. The sphere was then segmented mathematically into regions and each region was assigned an average temperature. The extent of chemical reaction was calculated by reference to TREAT results in which specimens reached a temperature similar to those reached in the SPERT-1 and SL-1 meltdowns. A summation over the sphere of melting then yielded an estimate of the total quantity of metal-water reaction. Results calculated from TREAT data yielded 2 Mw-sec of chemical energy for the SPERT-1 excursion and 26 Mw-sec of chemical energy for the SL-1 excursion. (auth)

19310 (ANL-6798) A FAST REACTOR EXCURSION SIMULATOR. Lawrence T. Bryant and D. V. Gopinath (Argonne National Lab., Ill.). Dec. 1963. Contract W-31-109-eng-38. 30p.

A simulator for studying fast reactor accidents by use of an analog computer is described. A flux plot or temperature distribution analysis can be made using only a 5×5 mesh of an average channel in the core. The equations, circuitry, and operating instructions for duplicating an EBR-II-type accident are covered. Results from the simulator for a sample problem are compared with a digital computer solution. (auth)

19311 (CEA-2389) CINETIQUE DE L'EMPOISONNEMENT SAMARIUM DANS LES PILES ATOMIQUES A TRES HAUT FLUX. (Kinetics of Samarium Poisoning in Very High Flux Reactors). J. Furet (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1963. 17p.

The general laws are given concerning the evolution of the samarium concentration in thermal neutron atomic reactors in the case of a uniform distribution of the neutron flux in the core. An analysis of the changes in the samarium poisoning alone and the samarium plus xenon poisoning is then made for various working conditions. The evolution of these poisonings is then studied in the case of further start-up of the reactor. A certain number of conclusions are given in connection with the reactivity balance and with the possibilities of a further set-up as a function of the average flux. (auth)

19312 (IKF-9) BILDUNG VON RADIOLYTISCHEN BLASEN UND IHR EINFLUSS AUF DAS DYNAMISCHE VERHALTEN VON WASSERKOCHER-REAKTOREN (THESE). (Production of Radiolytic Gas Bubbles and Their Influence on the Dynamic Behavior of Water Boiler Reactors (thesis).) K. Stelzer (Frankfurt am Main. Universitat. Institut fur Kernphysik). Oct. 1963. 128p.

Experiments performed in the normal operation range of the Water Boiler Reactor FRF (L-54-F) show that radiolytic gas bubbles are formed only after a critical energy input, when the fuel solution has become highly supersaturated with dissolved gas. The supersaturation observed can be shown to be high enough to allow a nucleation of gas bubbles by the recoil of fission fragments. A simplified dynamical model for water boiler reactors is developed, which includes the critical energy for bubble formation. For power excursions following large positive step reactivity insertions, an explicit solution can be obtained which gives the energy up to the power peak in terms of the reactor parameters including the critical energy for bubble formation. The results of the calculations are in good agreement with the results of the KEWB-experiments. (auth)

19313 (LA-3045) A FORMULATION FOR NUMERICAL SOLUTION OF THE INVERSE PROBLEM OF THE GENERALIZED REACTOR KINETICS EQUATIONS. J. W. Evans (Los Alamos Scientific Lab., N. Mex.). Oct. 1963. Contract W-7405-eng-36. 15p.

The general solution of the space independent reactor kinetics equations formulated by Keepin takes the form of an integral equation in which the neutron density is an implicit function of the time dependent reactivity. The equation also involves a set of tabulated constants. The problem of specifying the reactivity required to yield a given neutron density function is solved by exhibiting an explicit solution for the reactivity in terms of the density function and a set of constants related to those tabulated by Keepin. The only mathematical restriction on the density function is that it be positive and differentiable. The solution is suitable for numerical computation, and methods for calculating the constants are developed. As a simple application, the reactivity required to yield a constant density is shown to be a sum of negative exponentials. (auth)

19314 (ORNL-1320) THE EFFECT OF GAPS ON PILE REACTIVITY. S. Tamor (Oak Ridge National Lab., Tenn.). July 14, 1952. Contract W-7405-eng-26. 16p.

The variation of the reactivity of a pile as a function of width of a transverse gap is calculated. The method used involves finding the boundary condition satisfied by the flux at the gap face. This, in principle, provides enough information for a complete solution of the pile

equations. A method for calculating the reactivity change is presented. The calculated reactivity is compared with experiment, and the validity of the approximations is discussed. (auth)

19315 THE INTERACTIONS OF SUBCRITICAL REACTORS. V. G. Dubovskii, A. V. Kamaev, G. M. Vladykov, F. M. Kuznetsov, V. Z. Nozik, Yu. D. Palamarchuk, G. A. Popov, and V. V. Vavilov. At. Energ. (USSR), 16: 16-20 (Jan. 1964). (In Russian)

When determining the nuclear safety of systems containing fissionable materials, the interaction of all the components must be taken into consideration; however, this is often impossible to do in the case of subcritical systems. Approximations must therefore be used for estimating the safety margin of the interacting system. In order to facilitate the problem, an attempt was made to replace the given subcritical array consisting of materials possessing given nuclear properties and geometric parameters by a reactor that is equivalent to the first one with regard to the buckling, but has different nuclear properties; equations were obtained for determining the equivalent geometrical dimensions. The equations derived were experimentally verified on subcritical arrays containing cylinders and square parallelipipeds, made of stainless steel containers with a wall thickness of 1.5 to 2 mm and radii or sides of 30 cm, filled with an aqueous solution of 90%-enriched $^{235}UO_2(NO_3)_2$. Similar systems were also built with 6-liter capacity glass cylinders with 0.5-cm thick walls. Comparison of the experimental and theoretical values indicated that the latter contain a suitable safety margin and therefore may be used for evaluating the safety of an interacting system; this was proved by recalculating the data of E. Woodcock and U. Paxton (Progr. Nucl. Energy Series Vol. 4, 213 (1961)) concerning a system of U spheres. (TTT)

19316 DIFFERENT CORRELATION METHODS. APPLICATION TO THE MEASUREMENT OF HIGH ANTIREACTIVITIES OF A SUB-CRITICAL NUCLEAR REACTOR. Jean Valat. Compt. Rend., 258: 1704-7(Feb. 10, 1964). (In French)

For a given excitation, the intercorrelation between the exciting input and the resultant rise is better established than the autocorrelation of the rise in the case of a high internal background noise. On the contrary, the autocorrelation of the intercorrelation permits the statistical precision to be improved, but at the expense of the simplicity of extraction of the information desired. (tr-auth)

19317 A THEORETICAL APPROACH TO THE NEUTRON MULTIPLICATION EXPERIMENTS INVOLVING A SINGLE FUEL ELEMENT. PART 3. S. E. Corno (AGIP Nucleare, Milan). Energia Nucl. (Milan), 11: 75-91(Feb. 1964). (In Italian)

A detailed comparison of the homogeneous and the highly heterogeneous exponential experiments described in preceding parts is presented. In particular, a deep physical insight into the problems of the spatial superposition of spectrum transients due to source and interface effects is worked out. The separation of absorption and multiplication contributions to the flux inside the experimental device is considered. Some self-consistent procedures for the evaluation of the heterogeneous parameters are proposed. A few generalizations of the theory, mainly concerned with the problem of spikes, are suggested. (auth)

19318 CORRELATION-FUNCTION ANALYSIS OF SYSTEMS OBEYING LINEAR DIFFERENTIAL EQUATIONS—APPLICATION TO NUCLEAR REACTORS. M. Surdin and C. Kassimatis (Centre d'Etudes Nucléaires, Saclay, France). J. Nucl. Energy, Pt. A & B, 18: 61-6 (Feb. 1964).

It is shown that certain techniques of correlation analysis when applied to linear differential equations yield interesting results about the physical systems described by these equations. As an illustration of these techniques, the measurement of the reactivity δk of a subcritical reactor is proposed. This application, being quite general, yields as special cases three methods of reactivity measurements recently proposed and also treats a few new ones. (auth)

19319 SELF-LIMITING EXCURSION CHARACTERISTICS OF A WATER-MODERATED, LOW-ENRICHMENT UO_2 CORE. PART II. Yoichiro Yoshinaka and Minoru Ishige (Meidensha Electric Mfg. Co., Ltd., Japan). Meidensha Jiho, No. 48, 32-5(May-June 1963). (In Japanese)

A hazards analysis is made of the maximum credible accidents for a light-water-moderated, low-enrichment UO_2-fueled critical assembly. The maximum credible accidents postulated are (1) continuous withdrawal of the control rods concurrent with continuous increase in water level, which results in additions of reactivity at a rate of 5×10^{-4} $\delta k/k$ sec up to 2% $\delta k/k$, and (2) flooding of the instrument holes concurrent with withdrawal of the simulated voids, which introduces 0.5% $\delta k/k$ reactivity at a rate of 5×10^{-2} $\delta k/k$ sec. Since it is a UO_2 fueled assembly, its principal shutdown mechanism is the Doppler effect of the fuel. In addition to this, a manual scram is assumed, which dumps the moderator and introduces a negative reactivity at a rate of -0.1% $\delta k/k$ sec. The maximum power, the energy release, and the maximum fuel temperature rise for the above accidents are found to be 6.35/1.30 Mw, 36.6/12.4 Mw sec, and 836/303.2°C, respectively. The magnitude of the temperature coefficient of the Doppler effect is quite small. From the present analysis, it seems that the Doppler effect is less effective as the shutdown mechanism than the void coefficient of the metal-fueled, pool-type reactors. (from NSA of Japan)

19320 NUMERICAL INTEGRATION OF THE SPHERICAL-HARMONICS EQUATIONS. H. Waldinger (Polytechnic Inst. of Brooklyn), J. Agresta, and G. Goertzel. Nucl. Sci. Eng., 18: 459-67(Apr. 1964).

A method is formulated for numerical integration of the spherical-harmonics in the case of cylindrical geometry. This method avoids many of the difficulties of the usual analytical techniques and allows space-varying sources as well as regions of low neutron cross section and large physical size. The usual spherical-harmonic equations (truncated) are presented in cylindrical geometry. To obtain a set of equations that (because they are more intuitive in form) lead to readily manageable numerical solution, the equations are converted to the discrete ordinate form in cylindrical geometry. From the discrete-ordinate equations, one may readily discuss inward- and outward-going neutrons. Based on this, reflection matrices are introduced at each radius r, one describing the reflection of inwardly directed neutrons by the medium outward of r and the other describing the reflection of outwardly directed neutrons by the medium outward of r. The complete source-independent properties of the medium are described by these reflection matrices. Furthermore, the matrices can be obtained by numerical integration in a single pass, one by integrating from the center out and the other by integrating from the outside in. The source can be treated by considering at each radius r the flux that escapes outward due to sources inward of r and by considering separately the flux that goes inward due to sources outward of r. The first of these escape fluxes is obtained by integration outward from the origin, using the corresponding reflection matrix, the second by integration inwards. Once the above quantities are

found, the fluxes are obtained by solution of simultaneous algebraic equations (no further integrations). Numerical results necessary for the use of this method in the P_3 approximation are also given. (auth)

19321 REACTOR KINETICS ANALYSIS BY AN INVERSE METHOD. Raymond L. Murray, Carroll R. Bingham, and Chreston F. Martin (North Carolina State Coll., Raleigh). Nucl. Sci. Eng., 18: 481-90(Apr. 1964).

Solutions of the reactor kinetics equations for the reactivity variation required to achieve specified power responses are presented. This inverse approach is shown to extend the physical understanding of reactor behavior, to have utility in reactor operations, and to admit closed solutions for many otherwise non-linear problems. The inverse method is demonstrated by several examples: heating of a reactor at constant power, a ramp power rise followed by a constant level or by a linear drop, an oscillatory power, and a smooth transition between levels. Effects of a negative temperature coefficient may be described in terms of an additional fictitious delayed group. The constant-period response is shown to be optimum for a transition between two power levels. (auth)

Design and Feasibility

Refer also to abstract 17999.

19322 (ANL-6792(p.777-89)) CALCULATION OF DOPPLER COEFFICIENTS OF DILUTE FAST REACTORS. R. Froelich, K. Ott, and J. J. Schmidt (Kernforschungszentrum, Institut für Neutronenphysik und Reaktortechnik, Karlsruhe, Germany).

A method for calculating Doppler coefficients of dilute fast reactors is briefly outlined. The Doppler coefficients are calculated for two reactors for different temperatures, temperature distributions, sodium densities, and ^{238}U to ^{239}Pu ratios of 5 and 7. (C.E.S.)

19323 (LADC-5659) REACTORS OF UNIFORM POWER, FUEL-LOADING, AND FLUX. Bruce W. Knight, Jr. (Rockefeller Inst. for Medical Research, New York and Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 25p.

A tractable mixed numerical-analytic method is given for the approximate design of reflected reactors with cores having simultaneously flat power density, fuel loading, absorber distribution, and moderator distribution. The method as applied to finite cylinders yields a fast digital routine (about 1 sec/calculation on the IBM 704) which gives trustworthy criticality values in systems with important neutron capture at energies above thermal. Corroborative experiments on critical assemblies containing molybdenum and tungsten show power distributions flat to within ±5%. (auth)

19324 FIXED BED REACTORS. G. Perona (CISE, Milan). Energia Nucl. (Milan), 11: 92-100(Feb. 1964).

A new series of reactors that is gradually becoming a fundamental characteristic concept is reviewed. They can be divided into thermal and fast bed-reactors; alternatively they can be classified on the basis of the coolant, that can be gas (or steam), water or molten metal. A more suitable classification is that which distinguishes between fuel and moderator bed reactors and fuel bed reactors. The advantages of such core configurations are discussed and some examples are given. (auth)

19325 PRINCIPLES OF FAST-REACTOR PHYSICS. Ferenc Szabó (Central Physics Research Inst., Budapest). Magy. Fiz. Folyoirat, 11: 325-49(1963). (In Hungarian)

Fast reactors represent the only system able to create efficiently new fissionable material from ^{238}U and ^{232}Th thus increasing the world's energy reserve in the first case by a factor of 140. One of the interactions of the $^{238}U + n$ system is radiative capture, which ultimately yields the α-emitting, fissionable ^{239}Pu nucleus. The breeding ratio of thermal reactors is reduced by absorption in the moderator and the coolant and by neutron escape. Fast-reactor cores do not contain moderators. Decrease of the microscopic cross section must be compensated for by increased enrichment. Only liquid metals and alloys are considered satisfactory coolants for fast reactors. Criticality problems in reflected and unreflected systems were examined; the critical masses of Jesebel, Godiva, Popsy, and Topsy are tabulated. Unlike thermal reactors, the fast reactor's spectrum is not limited by the Maxwellian distribution; it should be known to the designer from calculation or direct measurements. The fuel composition affects the neutron economy. The choice of good absorbers for use in the control system is more limited than in the case of thermal reactors; only the relatively expensive ^{10}B is actually used. The hazards presented by the operation of fast reactors are considered difficult to evaluate at present. (TTT)

19326 DEVICE FOR PREVENTING THE BLOW OUT OF FUEL ELEMENTS FROM A NUCLEAR REACTOR CHANNEL. (to Électricité de France). French Patent 1,313,263. Nov. 19, 1962. Filed Nov. 15, 1961.

Some nuclear reactors have vertical channels provided in the moderator structure wherein the fuel elements are disposed and through which passes a gaseous coolant flow in upwards direction. During the discharging of such a channel it may happen that the pressure loss along the channel drops to such an extent that the resulting increased coolant flow forces the lower fuel elements out of the channel. Designs may be modified so that each channel is provided with auxiliary channels communicating at their lower ends with the channel entrance and at their upper ends with the channel at different levels corresponding respectively to the levels of the lower fuel elements. If any of these latter fuel elements facing the upper end of such an auxiliary channel is discharged, the by-pass flow through the auxiliary channel increases and creates unsupplementary pressure loss in the region of the reactor channel, which is already free from fuel elements, which results in a drop of the pressure loss along the remaining fuel elements and thus diminishes the hydrodynamic forces exerted on said fuel elements. (IIB)

19327 NUCLEAR REACTOR INSTALLATION. (to Sulzer Frères S.A.). French Patent 1,314,775. Dec. 3, 1962. Priority date Apr. 28, 1961, Switzerland.

In order to increase the thermal efficiency of a nuclear reactor installation, the reactor cooling channels having about the same heat development rate are grouped together, so that the entrance and exit headers of the different groups supply and remove the coolant at temperatures differing from one group to another. These group-headers communicate with different places of the heat exchanger casing while the heat exchanger casing comprises boiler tubes arranged in two cycles with different pressures. The heat exchanger casing is divided into two sections through which the reactor coolant successively passes, so that the group-exit headers communicate with one of the sections and the entrance headers with the other one, while a circulation pump for the coolant is interconnected between these sections. The working medium within the boilder tubes flows in countercurrent to the reactor coolant circulation within the heat exchanger sections. (IIB)

19328 NUCLEAR REACTORS. Ronald Parr and John Anthony Wynne Huggill (to AEI-John Thompson Nuclear Energy Co.). U. S. Patent 3,127,324. Mar. 31, 1964. Priority date Nov. 1, 1956, Great Britain.

A reactor of the heterogeneous type is designed for increased heat transfer. In this reactor, fuel plates are arranged to extend transversely or obliquely across one vertical channel so as to form a series of coolant channels. Each coolant channel is relatively short, so that the spacing between fuel plates can be made small, leading to a higher concentration of fuel. Several embodiments of the plate-channel design are described. (D.L.C.)

Fuels

19329 (CEND-197) BURNABLE POISON ADDITIONS TO UO_2. Progress Report, Period Ending, September 30, 1963. R. C. Brayer and W. P. Chernock (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Oct. 1963. Contract AT(30-1)-3107. 42p.

UO_2 fuel elements containing 0.05 wt % B_4C and having an axially located tungsten heater were compacted by the electromechanical method, to 85.5 ± 0.6% of theoretical density. Axial boron distribution was maintained within ±20% of the average value. Three rods were subjected to thermal gradients ranging from 9.3 to 11.6°C/cm resulting in a clad temperature varying in the range from 40 to 180°C and with a centerline temperature from approximately 1900 to 2000°C. One rod tested at a lower centerline temperature of 1500°C yielded results similar to those obtained at higher test temperatures. No significant boron migration either axially or radially was observed under these experimental conditions. (auth)

19330 (TRG-Report-54) THE EFFECTIVE EMISSIVITY OF A POLYZONAL CAN WITH SPLITTERS. A. C. Rapier and L. White (United Kingdom Atomic Energy Authority. Reactor Group, Windscale, Cumb., England). Apr. 25, 1961. Reprinted: 1964. 15p.

The calculation of the net rate of heat transfer by radiation between a polyzonal fuel element and a graphite channel can be simplified by replacing the fuel element by an arbitrary surface having an "effective" emissivity. A standard convention for selecting this surface is suggested. It is shown that the direct application of the simple formula for radiation between two "grey" bodies can lead to significant errors with shapes as complicated as that of a fuel element. The formula has been refined to allow for the very different view factors of the fin tips and splitters on the one hand and the can barrel and fin sides on the other, for the case when the splitters are at the same temperature as the can. An approximate solution is derived for the more general case in which the splitters are at a different temperature from the can. Numerical values are given for the "notional can" which is typical of the designs of polyzonal cans for Civil power stations. (auth)

19331 (EURAEC-687) HEAT-TRANSFER IMPROVEMENT IN BOILING WATER NUCLEAR REACTORS. Quarterly Report No. 12. (Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Suresnes, France). Mar. 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 058-61-7-RDF. 18p. (A translation).

The technological study of the insertion of twist strips into a fuel element of a boiling water reactor has made it possible to determine methods of fabrication and behavior of the twist strips. Vacuum fraction measurements effected by the gamma attenuation method or by the electrolytic pulse method on a four-rod channel traversed by a biphase water-air flow show that there is a variation of 6% between the results obtained by both methods, whereas dispersion is about 5% in either case. When a set of twist strips is inserted into a channel with 4 heating rods, critical fluxes are increased by 40% at atmospheric pressure. Tests are being carried out for the comparison of critical fluxes, with and without twist strips, at a pressure of 70 atmospheres. (auth)

19332 CERAMIC-COATED-PARTICLE NUCLEAR FUELS. R. W. Dayton, J. H. Oxley, and C. W. Townley (Battelle Memorial Inst., Columbus, Ohio). J. Nucl. Mater., 11: 1-31(Jan. 1964).

Ceramic-coated-particle nuclear fuels consist of small particles of the fuel material, coated with a thin, impermeable ceramic layer and dispersed in a ceramic matrix. Such fuel materials are of interest primarily because they hold promise of achieving complete fission product retention at high temperatures, using materials having low neutron absorption cross section and good corrosion resistance. The current technical status of such fuel materials is reviewed. Particles of fuel materials have been coated with pyrolytic carbon, beryllia, alumina, magnesia, zirconia, silicon carbide, and niobium carbide. They have been dispersed in graphite, BeO, and Al_2O_3, though few data have been reported for BeO matrices. Laboratory and in-pile evaluations of these materials are showing how to overcome difficulties experienced in early studies. Recent data have shown that essentially complete fission product retention can be achieved at temperatures above 1000°C, for burnups in excess of 6 per cent of metal atoms. (auth)

19333 BEHAVIOUR OF FUELS AT HIGH BURN-UP LEVELS. PART 2. THERMAL REACTOR FUELS. A. DISPERSED FUELS. J. B. Sayers (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Eng., 9: 96-101(Mar. 1964).

The behavior of $BeO-UO_2$ and $BeO-(ThU)O_2$ thermal reactor fuels at high burnup levels is investigated. (C.E.S.)

19334 DIRECT-CONTACT CORE SYSTEMS. R. Philip Hammond and John R. Humphreys, Jr. (Los Alamos Scientific Lab., N. Mex.). Nucl. Sci. Eng., 18: 421-5(Apr. 1964).

A fast-reactor concept is considered in which the recirculating molten plutonium alloy fuel is externally cooled by direct contact with an immiscible coolant fluid. An example of one such design is given using sodium as the coolant and Pu/Co/Ce ternary as the fuel. Operational characteristics are discussed showing the self-regulating features of the system. Some fission-product-removal mechanisms are considered together with their effect on core life and system safety. The principal problem areas are fuel pumping, phase separation, and containment-materials compatibility. (auth)

19335 THE EFFECT OF AXIAL HEAT CONDUCTION IN FUEL PLATES ON MAXIMUM HEAT FLOW RATES AND TEMPERATURES. J. R. Fagan and J. O. Mingle (Kansas State Univ., Manhattan). Nucl. Sci. Eng., 18: 443-7 (Apr. 1964).

The standard analytical approaches to calculating the maximum temperature and surface-heat-flow rate in reactor fuel plates over-estimates both of these quantities due to the omission of conduction along the axis of the plate. The more general problem, including axial conduction, has been solved for fuel plates in which the clad and meat can be assumed to have the same thermal properties. Calculations made for a natural-circulation reactor show over-estimates of the maximum surface heat flow rate of

4.5 percent and of the maximum temperature rise of 4.8 percent. The error is minimized for systems having a large convection heat-transfer coefficient and will be less than 0.5 percent for most power reactor systems. (auth)

19336 FUEL-IMPORTANCE FUNCTION AND MINIMUM CRITICAL MASS. Masuhiko Otsuka (Electrical Power Development Co., Tokyo). Nucl. Sci. Eng., 18: 514-17(Apr. 1964).

This discusses a representation of neutron balance in which the adjoint flux has no physically simple meaning. In this case, the function adjoint to the neutron absorption density may be defined as the fuel-importance function, and it plays the principal role in perturbation theory. Its application to the minimum-critical-mass problem gives a more physically clear interpretation. (auth)

19337 IMPROVEMENTS IN OR RELATING TO LOCATING MEANS FOR POSITIONING NUCLEAR FUEL COMPONENTS. Herman Joseph Hackett (to United Kingdom Atomic Energy Authority). British Patent 953,475. Mar. 25, 1964. Filed Feb. 20, 1962.

A spacer member is designed for positioning fuel tubes in reactor channels. The spacer member comprises a ring adapted to abut the complementary inclined end faces of adjacent fuel tubes and to offer projections between the fuel tubes and the channel wall. The ring is made of two halves coupled by lug and groove interconnections, and the projections are designed to overlap the fuel tubes. Dimensional changes in the fuel tubes and the ring can be accommodated by the clearances in the lug and groove interconnections in the ring and by sliding in the inclined planes of contact between the fuel tubes and the ring. (D.L.C.)

19338 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR USE IN NUCLEAR REACTORS. (to Philips' Gloeilampenfabrieken). British Patent 953,873. Apr. 2, 1964. Priority date June 3, 1959, France.

A fuel element is designed with a sheath which is permeable to infrared radiation, so that heat transport from the fuel to outside the sheath occurs by radiation as well as conduction. Suitable sheath materials are quartz and other Si compounds, and means such as Al_2O_3 rings may be provided to space the fuel from the sheath so that heat transport occurs entirely by radiation. The fuel element may be located within a moderator whose sides absorb infrared radiation. Several embodiments of the fuel element and/or moderator are described. (D.L.C.)

19339 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to Société Francaise des Constructions Babcock and Wilcox). French Patent 1,305,135. Aug. 20, 1962. Priority date Nov. 9, 1960, Germany.

Heterogeneous nuclear reactors with fuel elements able to hold back the gaseous fission products formed in them during the reactor operation are discussed. The pressure created by this fission product accumulation often causes the destruction of the fuel element cladding; therefore the nuclear fuel and an absorber for the gaseous products were placed within the same gas-tight cladding, the absorber being disposed within the reflector region of the reactor. Preferably the cladding is constituted of an impermeable graphite tube closed within the reflector region by a stainless steel thimble wherein the absorber, e.g., active carbon is placed. The nuclear fuel is suitably enclosed within short cylindrical containers of permeable graphite provided with axial grooves on its surface for the passage of the fission-product gases. (IIB)

19340 MEASURING DEVICE FOR MEASURING TEMPERATURE OF FUEL ELEMENTS IN REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,317,515. Jan. 2, 1963. Priority date Mar. 6, 1961, Great Britain.

Devices were designed for determining temperature by means of measuring the pressure of a fluid influenced by the temperature and were especially adapted to serve for measuring the temperature of fuel elements in a nuclear reactor. The devices consist of a diaphragm, the resonance frequency of which depends on the pressure; means for oscillating the diaphragm at frequencies comprising the resonance frequency; and means for measuring the resonance frequency. Preferably the means consist of a cavity filled with the fluid under pressure with the diaphragm forming a part of the cavity wall, an electromagnetic coil for vibrating the diaphragm, and means for detecting the resonance by measuring the resonant impedance of the coil. (IIB)

19341 MODULAR CORE UNITS FOR A NEUTRONIC REACTOR. Joseph F. Gage, Jr. and D. B. Sherer (to U. S. Atomic Energy Commission). U. S. Patent 3, 128,234. Apr. 7, 1964.

A modular core unit for use in a nuclear reactor is described. Many identical core modules can be placed next to each other to make up a complete core. Such a module includes a cylinder of moderator material surrounding a fuel-containing re-entrant coolant channel. The re-entrant channel provides for the circulation of coolant such as liquid sodium from one end of the core unit, through the fuel region, and back out through the same end as it entered. Thermal insulation surrounds the moderator exterior wall inducing heat to travel inwardly to the coolant channel. Spaces between units may be used to accommodate control rods and support structure, which may be cooled by a secondary gas coolant, independently of the main coolant. (AEC)

Power and Power-Breeder Reactors

19342 (ACNP-62842) SUBTASK 5.1—ACTIVITY CONTROL AND DECONTAMINATION REQUIREMENTS. Summary of Work, June 21–September 30, 1962. C. A. Bergmann (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C. and Allis-Chalmers Mfg. Co., Schenectady, N. Y.). Nov. 5, 1962. Contract AT(30-1)-2639. 20p.

Chemistry and radiochemistry tests were performed at the SM-1 and PM-2A sites. Evaluation of the data shows that SM-1 operation with a high pH coolant caused some significant shifts in the distribution of nuclides in the coolant. For example, at neutral pH operation, the major portion of ^{54}Mn activity was in the non-filterable portion of the coolant. At high pH operation, the major fraction of the ^{54}Mn activity appeared in the filterable fraction of the coolant. The ^{60}Co nuclide also exhibited an opposite trend in its distribution between the two coolant fractions when going from neutral to high pH operation. A similar change in the distribution of nuclides deposited on metal test coupons did not occur when going from neutral to high pH operation. The corrosion rate of type 304 SS appeared to be slightly less at high pH. Values of the observed gross fission iodine levels and gross total coolant activity found in the PM-2A coolant, indicate that no significant defects had occurred. The gross fission iodine levels in the PM-2A after 16 months of operation have not materially changed since those found during the first few days of operation. (auth)

19343 (ACNP-63586) FAST NEUTRON FLUX IN A MOCKUP OF SM-1A CORE AND VESSEL. F. G. Moote, L. D. Walthousen, and E. F. Clancy (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee. Aug. 1963. Contract AT(30-1)-3106. 83p.

Flux measurements were made in a cold (68°F) mockup of the SM-1A reactor core, thermal shields, and pressure vessel. Neutron flux distributions were mapped in radial and axial directions by means of detector foils to cover thermal, resonance, and fast neutron energy ranges. Multigroup calculations were also made for this cold mockup, using the P1MG-2 and PDQ (rz)-2 codes. These results were correlated with hot (430-440°C) measurements and calculations of the fast flux above 1 Mev in the SM-1A reactor, in order to assist in prediction of radiation damage effects on the pressure vessel. The experimental results were up to 30% higher than calculated flux value. The best estimate of the fast flux above 1 Mev at the pressure-vessel surface was 4.1×10^9 n/cm^2-sec-w for the cold mockup (68°F) and 9.4×10^9 n/cm^2-sec-w, for operating conditions (440°F). (auth)

19344 (ACNP-64006) PATHFINDER ATOMIC POWER PLANT—HIGH-LEVEL SOURCE ANALYSIS. P. S. Lacy and J. W. Lewellen (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Mar. 16, 1964. For Northern States Power Co., Minneapolis and Central Utilities Power Associates. Contract AT(11-1)-589. 40p.

The Sb-Be source intensity, neutron multiplication in the subcritical reactor, and the neutron flux at the sensor locations were calculated for the initial stage of startup. At this point, a high-level Sb-Be source is in the reactor, all control rods are inserted, all fuel positions are loaded, and BF_3 counters are installed in ports in the concrete shielding. Calculational uncertainties and measures to improve the neutron count rate were particularly considered. (D.C.W.)

19345 (ACNP-64516) HAZARDS REPORT FOR SM-1 CORE III. F. G. Moote (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). Jan. 1964. Contract AT(30-1)-3106. 33p.

The third core for the SM-1 reactor contains type-3 elements with increased fuel and boron loadings and plate thickness. It contains 37 fuel elements and 8 dummy elements, instead of the former 45 fuel elements. Detailed information on core dimensions, composition, special components, core nuclear characteristics, thermal and hydraulic characteristics, nuclear excursions, and loading procedures is presented. Plant operating conditions are the same as for Cores I and II-10.8 Mw full power and 440°F. There is no significant change in hazards due to the use of this higher performance core. (auth)

19346 (ACNP-64517) ZERO POWER EXPERIMENTS FOR SM-1 CORE III. F. G. Moote, L. D. Walthousen, J. L. Miles, T. M. Raby, and E. F. Clancy (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). Jan. 1964. Contract AT(30-1)-3106. 112p.

Reactivity comparisons with standards were made for each element, and measurements were made of critical size, shutdown and excess reactivity margins, and stuck-rod conditions. Detailed reactivity calibrations were made for each of the three different control rod radial positions and for the total reactivity of the 5- and 7-rod banks. The temperature coefficient was measured in the 70 to 140°F range, and flux and power distributions were extensively mapped over one-half of the core using ^{235}U fission foils. The core and experiments are described, and the results are presented, together with associated analytical results. (auth)

19347 (ANL-6788) FISSION-PRODUCT MONITORING IN EBR-I, MARK IV. R. R. Smith and C. B. Doe (Argonne National Lab., Idaho Falls, Idaho). Jan. 1964. Contract W-31-109-eng-38. 12p.

A description is given of the development and testing of a monitoring system which announces and analyzes the seriousness of a fuel cladding failure. The system is based on the method of passing the cover gas of the NaK coolant system through an electrostatic precipitation unit, passing the wire carrying the neutralized daughters of the rare gas fission products through a Hg trap gas seal into some water, and counting the resulting radioactive water. Since ^{41}K, the daughter of ^{41}Ar, is inactive, the water activity is almost exclusively that of the various Rb and Cs fission products. The equipment is described, and results are reported of some experimental tests. The discrimination against ^{41}Ar was found to be satisfactory, and essentially all the water activity was due to ^{88}Rb, ^{89}Rb, and ^{138}Cs. The background components were separated and compared, and the ratio of the normal Rb-Cs activity to the other background components is 0.58. Results of a failure simulation experiment using unclad enriched U foils indicated that the failure of a Mark-IV fuel rod cladding would be detectable. (D.L.C.)

19348 (ANL-6792) PROCEEDINGS OF THE CONFERENCE ON BREEDING, ECONOMICS AND SAFETY IN LARGE FAST POWER REACTORS, OCTOBER 7-10, 1963. (Argonne National Lab., Ill.). Dec. 1963. Contract W-31-109-eng-38. 912p. (CONF-334)

Nuclear data, reactivity coefficients, core meltdown and the maximum accident, performance, fuels, economics, safety, Doppler effect theory, and Doppler experiments are discussed for fast power breeder reactors. Separate abstracts are prepared for 22 of the 46 papers presented. The remaining papers were previously abstracted in NSA (17: 40261, 18: 4293, 4752, 4790, 4799, 7855, 7856, 7900, 7918, 7946, 9573, 9602, 9629, 9637, 9638, 9644, 9700, 9738, 11378, 11406, 11407, 11408, 11464, 11469). (C.E.S.)

For abstracts of individual papers see: 18280, 18863, 18864, 18865, 18866, 18867, 19322, 19349, 19350, 19351, 19352, 19353, 19354, 19355, 19356, 19357, 19358, 19359, 19360, 19361, 19362, and 19363.

19349 (ANL-6792(p.75-95)) COMPARISON OF DOPPLER AND SODIUM-VOID COEFFICIENTS OF DILUTE FAST REACTORS. K. Ott and K. E. Schroeter (Kernforschungszentrum. Institut für Neutronenphysik und Reaktortechnik, Karlsruhe, Germany).

The sodium-void and Doppler coefficients were calculated for oxide-fueled, sodium-cooled, fast reactors. Calculations were made with 100, 75, 50, 25, and 0% of relative sodium density. (C.E.S.)

19350 (ANL-6792(p.99-112)) MELTDOWN STUDIES. C. Dickerman, E. Sowa, L. Robinson, and D. Gopinath (Argonne National Lab., Ill.).

Accidents resulting from fuel element meltdown in fast power reactors were discussed. The discussion was based on experiments on the failure of EBR-II fuel elements in TREAT. (C.E.S.)

19351 (ANL-6792(p.193-202)) PARAMETER DEPENDENCE OF AFTER-MELTDOWN ACCIDENTS. H. Boehm (Kernforschungszentrum. Institut für Neutronenphysik und Reaktortechnik, Karlsruhe, Germany).

The energy release in after-meltdown excursions is investigated in the framework of the Bethe-Tait model with the use of a refined equation of state. With a sufficient degree of accuracy the equation of state can be

approximated as a polynomial in powers of the energy. The nonlinear system of differential equations describing the time behavior of the neutron flux during the second excursion is solved analytically. This permits an easy investigation of the dependence of the energy release on all the parameters involved; composition, void fraction, critical mass, ramp rate, initial flux, and uncertainties of the equation of state. As examples, the dependence on initial flux and ramp rate for a system containing fuel and fertile material in the ratio 1:5 are given. (auth)

19352 (ANL-6792(p.203-32)) FAST REACTOR MELTDOWN EXPERIMENTS. John B. Nims, Jr. (Atomic Power Development Associates, Inc., Detroit).

An experimental approach to fast reactor meltdown studies is outlined. Information that may be obtained and its interpretation are discussed. It is assumed that a coolant perturbation initiates the meltdown and that the power level remains constant until meltdown begins. Upon melting the fuel is assumed to escape from the clad and move under gravity toward the core center. (C.E.S.)

19353 (ANL-6792(p.315-28)) PuO_2–SS FUEL IN A FAST REACTOR. A. A. Shoudy, Jr. (Atomic Power Development Associates, Inc., Detroit).

The use of PuO_2 dispersed in stainless steel for fast reactor fuel elements is considered. The experimental behavior of PuO_2–stainless steel fuels are compared with that of PuO_2–UO_2 fuels. (C.E.S.)

19354 (ANL-6792(p.419-33)) FAST NEUTRON BREEDER ECONOMICS. Robert J. Creagan (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh).

The economic environment concerning fast breeder reactor power plants is compared with conventional and water reactor power plants, and the goals to be met in order to make the fast breeder plant competitive are discussed. The economic factors discussed include market, competition, availability of materials, potential advantages, problem areas, and research and development. (C.E.S.)

19355 (ANL-6792(p.455-71)) A STUDY OF THE FUTURE ECONOMIC PROSPECTS FOR FAST REACTORS. B. I. Spinrad, L. E. Link, and J. T. Weills (Argonne National Lab., Ill.).

The future economic prospects of fast power breeder reactors were discussed, based on a series of normalized optimal reactor configurations, operating conditions, secondary-system criteria, and fuel cycles of fast reactors. (C.E.S.)

19356 (ANL-6792(p.473-93)) SOME IDEAS ON THE REACTIVITY COEFFICIENTS IN THE FAST LARGE REACTORS. C. P. Zaleski (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Cadarache).

The principal mechanisms through which the temperature affects the reactivity in large fast power reactors are investigated. Fuel displacement, Doppler effects, sodium effects, and stability are discussed. The influence of different fuels on the sodium coefficient and the maximum hypothetical accident are examined. (C.E.S.)

19357 (ANL-6792(p.515-37)) OPTIMIZATION AND SAFETY OF HELIUM-COOLED FAST BREEDERS. Dieter Smidt (Kernforschungszentrum, Karlsruhe, Germany).

The feasibility of a helium-cooled fast power breeder reactor is considered. The primary advantages and disadvantages of gas cooling, cooling and pumping power with helium, the loss-of-coolant accident, hot spots depending on geometry, design of the subassembly, core design, arrangement of pressure vessel, and primary circuit and heat exchangers are discussed. (C.E.S.)

19358 (ANL-6792(p.553-70)) MOLTEN-SALT FAST REACTORS. L. G. Alexander (Oak Ridge National Lab., Tenn.).

The advantages of a molten-salt fast breeder reactor that has a mixture of NaCl, KCl, and (Pu, $^{238}U)Cl_3$ for the fuel stream are considered. The system maintenance, fuel processing, fuel containment, cooling systems, and coolant are discussed. (C.E.S.)

19359 (ANL-6792(p.643-61)) NEUTRON-CONTROLLED EXPANSION FUEL FOR FAST BREEDER REACTORS. F. M. Heck (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh).

The problem of achieving a safe and controllable fuel for a fast breeder reactor is considered. The problem and its solution are discussed in the context of certain requirements and compromises that seem to be required by the large fast breeder. Various ceramic fuels are evaluated, and controlled expansion, controlled bowing, design considerations, and stability are discussed. (C.E.S.)

19360 (ANL-6792(p.765-75)) DEPENDENCE OF FAST REACTOR DOPPLER COEFFICIENTS ON NUCLEAR DATA UNCERTAINTIES. R. Froelich, K. Ott, and J. J. Schmidt (Kernforschungszentrum Institut fÜr Neutronenphysik und Reaktortechnik, Karlsruhe, Germany).

An example of how the reliable theoretical prediction of fast reactor Doppler coefficients depends upon the inaccuracies of the nuclear data involved is discussed. Isothermal Doppler coefficients are considered for a reference reactor consisting of $^{239}PuO_2$, $^{238}UO_2$, sodium, and stainless steel. The present knowledge and uncertainties of relevant nuclear resonance data for ^{238}U and ^{239}Pu are discussed, and local Doppler coefficients for these two isotopes are calculated. (C.E.S.)

19361 (ANL-6792(p.791-802)) METHODS OF EVALUATION OF EFFECTIVE CROSS SECTION FOR DOPPLER COEFFICIENT CALCULATION IN LARGE FAST BREEDER REACTORS. C. Graves (United Nuclear Corp. Development Div., White Plains, N. Y.).

The uncertainties in the methods of predicting effective cross sections and the calculation of correction factors to permit rapid calculation of effective cross sections for various fertile and fissile materials are considered. The effect of resonance overlap in the unresolved resonance region on the predicted Doppler coefficient is discussed. The variation in effective radiative capture cross section for ^{238}U and the variation in effective fission cross section for ^{239}Pu with neutron energy and temperature are calculated. (C.E.S.)

19362 (ANL-6792(p.823-52)) MEASUREMENTS OF THE DOPPLER COEFFICIENT IN LARGE FAST POWER REACTORS USING A FAST CRITICAL ASSEMBLY AND AN EXPERIMENTAL FAST REACTOR. PART I. THEORETICAL ASPECTS OF THE MEASUREMENT OF THE DOPPLER COEFFICIENT IN A CRITICAL FACILITY. F. Storer, A. Khairallah, and J. Ozeroff (France. Commissariat á l'Énergie Atomique. Centre d'Études Nucléaires, Cadarache).

A reactivity method and an activation method for measuring the Doppler coefficient of samples in a critical assembly are outlined. Samples of ^{238}U and ^{239}Pu are used. (C.E.S.)

19363 (ANL-6792(p.853-72)) MEASUREMENTS OF THE DOPPLER COEFFICIENT IN LARGE FAST POWER

REACTORS USING A FAST CRITICAL ASSEMBLY AND AN EXPERIMENTAL FAST REACTOR. PART II. USE OF RAPSODIE FOR THE MEASUREMENT OF THE DOPPLER COEFFICIENT OF FAST POWER REACTORS. J. Ladet, I. Puig, and L. Stevens (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Cadarache).

Two methods for measuring the Doppler coefficient in large fast power reactors using PuO_2–UO_2 fuel elements are outlined. Measurements are to be performed on a 400-liter core placed in Rapsodie. (C.E.S.)

19364 (CVNA-201) MONTHLY OPERATING REPORT, FEBRUARY 1964. (Carolinas Virginia Nuclear Power Associates, Inc., Parr, S. C.). Contract [AT(30-1)-2289]. 32p.

The reactor was not operated. At the beginning of the month, the CVTR experienced a loss of electrical power supply to the plant due to a fire in the air circuit breaker on the emergency stub bus. The startup test S.U. CV-56, "Controlling Procedure for the Wet Refueling Operation," was completed. Several fuel elements and pressure tubes were removed from the core and header cavity and then later reinstalled as a part of this wet checkout. This test showed that the refueling machine and other related equipment would function as required. Some maintenance work remains to be done on the U-tube drying station. The installation of new header cavity insulation was completed. Leak rate tests showed the helium loss from the header cavity to be low and within acceptable limits. Preparations were made to complete the physics test, S.U. CV-45. During the checkout, difficulties were encountered with the control rod drive system. Scram times for the rods showed significant increases over those previously determined. It was observed that the scram times made when the header cavity was at higher temperature were less. (auth)

19365 (EGCR-1) AXIAL TEMPERATURE AND PRESSURE DISTRIBUTION IN EGCR. DEVELOPMENT OF THE PTD-1 PROGRAM. James C. Robinson and James T. Lence (Tennessee Valley Authority, Oak Ridge, Tenn.). Feb. 18, 1964. Contract [AT(40-1)-2742]. 60p.

The equations and procedures of the PTD-1 program for obtaining the surface temperature distribution, the gas bulk temperature, and the pressure distribution for any of the 234 channels in the EGCR are developed. The program, in FORTRAN for the IBM 7090, is designed for any arbitrary power distribution yielding a constant gas outlet temperature or a given maximum surface temperature and includes the effects of thermal radiation on surface and bulk gas temperatures. The flow sheet and some results are included. (auth)

19366 (EGCR-2) FATT—A TRANSIENT TEMPERATURE COMPUTER PROGRAM FOR THE EGCR CORE. Don C. Keeton (Tennessee Valley Authority, Oak Ridge, Tenn.). Feb. 25, 1964. Contract [AT(40-1)-2742]. 42p.

The computer program FATT for calculating the transient temperature distribution in the EGCR core is described. The program, in FORTRAN for the IBM 7090, provides an arbitrary choice of axial increments for the reactor core. The heat transfer coefficients are made temperature-dependent. Provisions are available for plotting the results from the program on the Calcomp plotter. The equations and some typical results are included, and the finite difference method of solution is described. (auth)

19367 (GEAP-4320) PHYSICS DESIGN OF THE MIXED-SPECTRUM CRITICAL ASSEMBLY. A. B. Reynolds (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Aug. 1963. Contract AT(04-3)-189. 214p.

The assembly will be a mockup of the Mixed Spectrum Superheater Reactor, an integral superheater reactor in which boiling occurs in an annular thermal section and steam is superheated in an unmoderated fast section in the center. The assembly is described, and the results of physics design calculations are presented. Power distributions, criticality parameters, loadings, reactivity distributions, control system and core worths, reactivity due to Doppler effect and axial fuel expansion in the fast section, effects of flooding the fast section, and thermal-core Doppler and void coefficients were calculated. Three methods under consideration for the measurement of the Doppler effect in the fast core are also discussed. (D.C.W.)

19368 (HPR-33) HBWR QUARTERLY PROGRESS REPORT, OCTOBER–DECEMBER 1963. (Norway. Institutt for Atomenergi. OECD Halden Reaktor Prosjekt). Mar. 1964. 212p.

Developments at the Halden Boiling Water Reactor are reported. Operation, reactor statics, reactor dynamics, water chemistry, data handling, in-core instrument development, application of in-core instruments and test facilities are discussed. (M.C.G.)

19369 (HW-79637) PRTR AUTOMATIC CONTROLLER TEST WITH ANALOG COMPUTER SIMULATED REACTOR. P. J. Dionne, B. E. Dozer, and R. A. Harvey (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 11, 1963. Contract AT(45-1)-1350. 24p.

The results of the test indicate that the control system is stable. Controller settings were varied in an attempt to determine the point of self oscillation, but the system resisted any tendencies toward instability. A wide range of controller settings seem to be entirely satisfactory. Optimum control resulted with 200% proportional band, 15 repeats/minute reset rate, and a 0.05-min rate setting. (auth)

19370 (IDO-28621) ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. Quarterly Progress Report, October 1–December 31, 1963. (Aerojet-General Nucleonics, San Ramon, Calif.). Feb. 15, 1964. Contract AT(10-1)-880. 100p.

The ML-1 power plant did not operate during the report period; low power reactor physics and shielding experiments were conducted with the ML-1 reactor. Evaluation of moderate corrosion observed on aluminum parts exposed to the ML-1 shield solution indicated no loss of performance capability. Preliminary tests showed that the corrosion probably was caused by heavy metal ions or chlorides in the solution. Massive corrosion observed on the ML-1 fuel element lower spiders was attributed to sub-standard material; failure of some spiders was attributed to a combination of corrosion and sub-standard fabrication. Evaluation indicated that the upper spiders will perform satisfactorily for the design lifetime. Modification, repair, and reassembly of the CSN-1A t-c set was completed. Operation demonstrated bearing stability, but showed that the turbine effective flow area was too large. A bypass flow path in the turbine was being corrected. The TCS-670 t-c set will be stored indefinitely. Since a commercial alternator will be used for the ML-1A, further development of the brushless alternator was postponed indefinitely. Evaluation revealed that the ML-1 improved precooler design was not compatible with ML-1A requirements. Operation of the IB-17R-2 and -3 test elements in the GETR continued without incident. Prelimi-

nary design of the ML-1A power plant was initiated. Design of modifications to the GCRE facility to adapt it to testing the ML-1 reactor skid was initiated. (auth)

19371 (JAERI-1049) ON NUCLEAR DESIGN OF THE SEMI-HOMOGENEOUS, HIGH-TEMPERATURE, GAS-COOLED REACTOR. Sigeru Yasukawa, Takeji Ise, Akira Tachibana, Hideo Nakano, and Toyohiko Kikuti (Japan Atomic Energy Research Inst., Tokyo). Mar. 1963. 68p. In Japanese.

The nuclear characteristics of the high-temperature, gas-cooled, power reactor using semi-homogeneous fuel elements were calculated including the critical mass, neutron flux and power distributions, burnup, temperature coefficient, conversion ratio, poisoning effect, and reactivity effects of the reflector and fuel elements. The nuclear constants used are tabulated, and the results are given. (D.C.W.)

19372 (JAERI-1054) SAFETY EVALUATION OF LIGHT-WATER-MODERATED POWER REACTOR. Yasumasa Togo (Japan Atomic Energy Research Inst., Tokyo). Mar. 1963. 188p. (In Japanese)

Important problems associated with safety evaluation are reviewed. In contrast to "absolute safety," the concept of "social safety" is explained and factors to compose "social safety" are evaluated. Some comments are made on the philosophy of safety evaluation. A core spray and enclosure spray systems, which are essential with respect to safety evaluation of the maximum credible accident of light-water-moderated power reactors, are analyzed in detail. In evaluation of a core spray system, detailed analysis is made on loss-of-coolant accident, and effects of core spray system design (spray initiation time, spray flow rate, spray distribution, etc.) on fission release are quantitatively clarified. In evaluation of an enclosure spray system, various product release reduction factors are calculated and relative importance of an enclosure spray system is discussed. A hypothetical accident is analyzed. (auth)

19373 (MND-M-1855) AIR-COOLED CONDENSER MODEL PERFORMANCE TESTS. C. C. Peake and M. B. Eck (Westinghouse Electric Corp. Steam Div., Lester, Penna.). Apr. 29, 1960. For Martin Co. Nuclear Div., Baltimore. Contract AT(30-1)-2345. 104p.

The air-cooled steam condenser model was tested at ambient air temperatures of 70°F to −65°F. Tests included de-icing, start-up procedures, low load operation, transient and steady state operation. The tests at 70°F demonstrated that the design concepts were sound. The anticipated heat transfer capability was attained, and the controls satisfactorily performed their required functions. At sub-freezing temperatures, it was found that the model could be de-iced, started, and operated over a wide range of load conditions. Some damage was experienced at −45°F and −65°F due to freezing of condensate in the tubes during low load transients, and differential expansion during start-up. Analysis of the mechanical failures and study of venting problems encountered under certain test conditions dictate design changes to make the prototype condenser fully operational over the required range of loads and ambient temperatures. (auth)

19374 (NAA-SR-Memo-9490) 200-Mwe SGR CONTROL AND FUEL ELEMENT TRANSIENT (AFTER SCRAM) THERMAL ANALYSIS. J. K. Imig (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 4, 1964. Contract AT-11-1-GEN-8. 17p.

The transient temperatures in the control rod and sodium coolant in the control element unit cell were determined for two control element flow decays. The transient temperatures in the fuel element unit cell were also determined. (D.C.W.)

19375 (NP-13714) OPREDELENIE EFFEKTIVNOSTI REGULIRUYUSHCHIKH STERZHNEI V SBORKAKH REAKTORA VVER. (Determining the Efficiency of Control Rods in Light Water Power Reactor Assemblies). V. N. Semenov, G. L. Lunin, L. V. Komissarov, A. N. Kamyshan, V. I. Khalizev, G. Ya. Andrianov, V. A. Voznesenskii, V. A. Kuz'micheva, and V. I. Lebedev (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoĭ Energii). 1963. 28p.

Efficiency of control rods in water reactors with constant moderating and scattering properties was analyzed. The results of critical experiments indicated the feasibility of using one-group conditions for a reactor with absorbers. In such a case the neutron distribution is described by the one-group diffusion equation with boundary conditions at the absorber surfaces and the reactor outer boundary. Calculations of absorber efficiency for a homogeneous zone (k_∞ = cons) are reduced to a determination of geometric reactor parameters, and in the case of a heterogeneous zone (where breeding properties are a function of coordinates) the problem is resolved by determining the minimum of a certain function. Calculations were made of the efficiency of water-filled absorbers and of the effects of water-filled channels in both homogeneous and heterogeneous assemblies. Results are given from experimental studies of thick absorbers. (tr-auth)

19376 (ORNL-TM-714) NUCLEAR ANALYSIS OF THE MH-1A REACTOR. E. E. Gross and M. L. Winton (Oak Ridge National Lab., Tenn.). Apr. 1964. Contract W-7405-eng-26. 29p.

The conceptual design of the MH-1A reactor was analyzed using machine codes and methods previously shown to give good agreement with experimental measurements for a similar core. The cold clean reactivity worths of all 12 control rods and of the most important control rod were calculated to be $\Delta k = 0.20$ and $\Delta k = 0.035$, respectively. This indicates that the reactor can be adequately shut down with one rod stuck in the fully-withdrawn position. A radial peak-to-average power ratio of 1.63 was calculated for the case with followers in the core. The reactivity lifetime of the core was calculated to be 11 months for the initial core. Additional calculations showed that the first fuel "shuffling" gave a core with the same lifetime. (auth)

19377 (TID-20396) HNPF OPERATING EXPERIENCE AND TESTING TO 250 MWt TO NOVEMBER 1, 1963. Emerson Jones and J. Denny Cochran (Consumers Public Power District, Lincoln, Neb.). Nov. 1963. Contract AT (11-1)-513. 18p.

Operating experience on the HNPF acquired up to Nov. 1, 1963 and the formal testing of the plant to 250 Mw(t) are described. Planned testing of the HNPF to 100% power has been completed. Following the formal testing program, the reactor plant was operated on a load-following basis. A description of the plant and plant design and construction is given, along with plant startup. (P.C.H.)

19378 (WCAP-2258) 1000-MWE SUPERCRITICAL PRESSURE NUCLEAR POWER PLANT STABILITY ANALYSIS. W. E. Gunson (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). May 1963. Contract AT (30-1)-2948. 292p.

A mathematical model (derived) was used to investigate

the system frequency response characteristics and stability behavior as a function of selected variables that would be actuated by a control system. The results are presented. The model represents the condensing steam reheat concept (described), but does not include a control system. The frequency response characteristic curves indicate that the concept has open-loop stability and closed-loop instability. Therefore, the control system must have additional compensating elements in the feedback circuit for the closed-loop instability points. No difficulties are expected in the design of a control system for the 1000-Mwe SCOTT-R. (D.C.W.)

19379 (WCAP-2564) 1000-MWE SUPERCRITICAL PRESSURE NUCLEAR REACTOR PLANT STUDY. Eighth Quarterly Progress Report, October 1, 1963–December 31, 1963. G. B. Brown and H. B. Kellogg, eds. (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Jan. 1964. Contract AT(30-1)-2948. 81p.

Modification of the high-temperature supercritical-pressure heat transfer loop in preparation for the corrosion test program was completed. Fabrication of the three test sections for the stress corrosion experiments was continued. Reduction and analysis of the heat transfer data obtained from the loop were continued. Information is included on forced convection heat transfer to saturated and superheated steam at high pressure and high Prandtl numbers, forced convection heat transfer to water at near critical temperatures and supercritical pressures, and forced convection heat transfer after DNB in the stable film boiling region. A preliminary thermal-hydraulic analysis of the 1000 Mw(e) SCOTT-R core is underway using the final reference heat transfer correlation developed under the experimental heat transfer program. (auth)

19380 THE BEHAVIOR OF BORATES AND OF BORIC ACID IN BOILING-WATER REACTORS. D. G. Tskhvirashvili and V. V. Galustashvili. At. Energ. (USSR), 16: 65-7 (Jan. 1964). In Russian)

In order to examine the feasibility of a liquid control system for boiling-water reactors, previous studies on the partition of boric acid and of Na and NH_4 borates between the vapor and the liquid phases (Trudy Inst. Energ. AN Gruz SSR XVI, 63 (1962)) were continued. The dependence of the partition coefficients of H_3BO_3, $NH_4B_5O_8$, $Na_2B_4O_7$, and $Na_2B_5O_8$ on the density ratios of the phases, the concentration, and the pH of the solution was investigated. On the basis of the study, the hydrolysis of these compounds and the mechanism of their passage into the vapor phase was clarified. It was found that materials usually present in water, such as NaCl and Na_2SO_4, and the corrosion products of the structural metals do not affect the partition coefficient. The results obtained in this study agreed well with the data reported on the basis of the operational experience of the EBWR; this indicated that the neutron flux does not influence the process of the passage of the borates into the vapor phase. The distribution of the unstable anions, especially at low pressures, exhibited sudden changes as a function of the pH. The data obtained may be used to determine the borate balance in the heat-transfer agents of power reactors on the basis of their solubility in the water and vapor phases. (TTT)

19381 STATE OF POWER REACTOR CONSTRUCTION IN THE GERMAN FEDERAL REPUBLIC. Kurt Jaroschenk (Technische Hochschule, Darmstadt, Ger.). At. Strom, 10: 1-6(Jan. 1964). (In German)

The present state of development of power reactors in Germany is summarized. The reactor types constructed are light water-cooled pressurized-water and boiling reactors, gas-cooled natural uranium reactors, heavy water reactors, BBC/Krupp reactor, high-temperature gas-cooled reactors, high-temperature reactor with sealed gas turbine circuit, organic-moderated reactors, and sodium-cooled zirconium hydride-moderated reactors. The short-range reactor development program is briefly reported. (J.S.R.)

19382 INSPECTION OF THE STEEL PLATE FOR THE PRESSURE VESSEL OF TOKAI ATOMIC POWER STATION. Shigeru Miyoshi (Fuji Electric Mfg. Co., Ltd., Japan). FAPIG, (Tokyo), 27: No. 2, 137-41(Aug. 1963). (In Japanese)

The English-made Coltuf-28-type steel plate, which was intended for use at the station, was found to have many H-embrittlement cracks as well as other defects and was therefore discarded. Steel plate was then ordered from the Nippon Seiko Co. in Japan. Acceptance tests were made on steel plates made from ingots produced in trial heats by open-hearth and electric furnaces. Tests included H embrittlement, ultrasonic, magnaflux, impregnating, mechanical, and 2-month-delay fracture tests. Problems in the ultrasonic and magnaflux inspection methods are discussed. The tests showed that the Japanese steel plate was acceptable, and manufacturing of the plate was continued. (NSA of Japan)

19383 ECONOMIC PROSPECTS FOR POWER PRODUCTION FROM NUCLEAR ENERGY. AN ANALYSIS OF PRESENT OPINIONS AND KNOWLEDGE. Heinz Schraer. Glueckauf, 99: 701-5(June 1963). (In German)

The unresolved factors in the economic evaluation of nuclear power production include lifetime of the nuclear power plant, burnup time of the fuel elements, and annual number of hours of utilization. These factors are discussed. The development of nuclear power in Germany and other countries is reviewed, and its possible contribution to the total power consumption is estimated. Future prospects of coal in power production are discussed. (J.S.R.)

19384 THE CONSTRUCTION OF JPDR. (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo). Ishikawajima-Harima Giho, No. 14, 560-5(Nov. 1963). (In Japanese)

JPDR (Japanese Power Demonstration Reactor), the first nuclear power station in Japan, went critical on August 22, 1963. The construction of the plant at Tokai-mura and special features of the plant are described. (NSA of Japan)

19385 JPDR REACTOR ENCLOSURE. (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo). Ishikawajima-Harima Giho, No. 14, 566-76(Nov. 1963). (In Japanese)

The reactor enclosure for the JPDR (Japanese Power Demonstration Reactor) was designed and constructed by IHI. Since this is the first reactor enclosure in Japan, many unique engineering problems were encountered at each step of the work. Some problems in design and shop fabrication are described. Several special topics are discussed, including stress analysis for internal pressure and shell temperature rise adjacent to the sand fill, dynamic analysis for earthquakes, and interesting welding techniques. (NSA of Japan)

19386 JPDR NUCLEAR STEAM SUPPLY SYSTEM EQUIPMENTS AND PIPING SYSTEMS. (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo). Ishikawajima-Harima Giho, No. 14, 577-83(Nov. 1963). (In Japanese)

More than 20 main equipment pieces were installed in the Reactor Enclosure and Turbine Building for the Japanese Power Demonstration Reactor. Each had problems of fabri-

cation and installation peculiar to the atomic power plant. These problems are discussed with emphasis on the heat exchangers, poison tank, and station piping. New techniques were employed in fabricating this equipment. (NSA of Japan)

19387 PRODUCTION OF THE PRESSURIZED VESSEL OF A ELECTRIC POWER REACTOR AT TOKAI VILLAGE. Toshio Takaichi (Fuji Electric Mfg. Co., Ltd., Japan). J. Japan Soc. Mech. Engrs., 66: 959-67(July 1963). (In Japanese)

Fabrication of the pressure vessel for the graphite-moderated, carbonic-acid-gas-cooled electric power reactor under construction at Tokai Village is discussed. Welding problems and requirements and quality control for the steel plates are described. The plates were renormalized after hot-rolling at normalizing temperature and then tested for required tensile strength, flexibility, hardness, and microscopic structure. Many pieces were given breaking tests as well as x-ray, ultrasonic, and magnetic inspection. Model welding tests identical with actual welding procedures were applied to critical and complicated structural parts of the pressurized system. A test for supporting parts of the reactor vessel is described. Welders were required to pass an examination before employment. (from NSA of Japan)

19388 ON THE LIMITATIONS OF LOAD CHANGE, MINIMUM LOAD OPERATION AND QUICK STARTING OF CONVENTIONAL AND NUCLEAR POWER STATIONS. Toru Kobayashi (Tokyo Electric Power Co.). Karyoku Hatsuden, 14: 424-40(June 1963). (In Japanese)

Conventional thermal power plants and nuclear power plants of the light-water-type are discussed from the standpoint of control, considering simplified transfer functions and their time constants. The nuclear power plants, with their inherent self-controlling feature, have better kinetic characteristics. This fact is made clear from the results of several operational tests conducted at Dresden, Yankee, and Shippingport nuclear plants and at conventional power plants. Various factors that limit the minimum load operation of power stations are investigated. For the conventional power stations, boilers are the main limiting factor, especially in once-through boilers. Some new methods for this problem are described. In the case of nuclear power stations, the minimum load operation may depend on turbines, not reactors. Thermal stress is the primary factor to limit quick starting of conventional and nuclear power plants. The practical heating rate of pressure vessels is the same or less severe than that of boiler drums. (NSA of Japan)

19389 MATERIALS FOR BOILING WATER AND SUPERHEATED STEAM NUCLEAR POWER REACTORS. W. R. Smith, Sr. (General Electric Co., San Jose, Calif.). Mater. Res. Std., 4: 170-4(Apr. 1964).

Materials for boiling water reactors are selected primarily for corrosion resistance. In general, Type 304 austenitic stainless steel or carbon steel clad with Type 304 is used to contain the reactor coolant. Exceptions are the fuel cladding and fuel structural parts that are often made of zirconium alloys to reduce neutron absorption in the reactor core. Superheated steam reactors will use the same materials as conventional superheated steam plants except in the core area, where wet steam appears to dictate the use of high-nickel alloys such as Inconel 600 or Incoloy 800. Current ASTM specifications appear adequate for materials other than thick plates and forgings that require accelerated cooling. Nondestructive testing specifications for radiographic and ultrasonic procedures are inadequate and should be modified to provide adequate controls of the testing process. (auth)

19390 ACHIEVEMENT OF FULL POWER OPERATION OF THE DFR. J. L. Phillips (United Kingdom Atomic Energy Authority). Nucl. Eng., 9: 10-16(Jan 1964).

Commissioning stages, preparation for operation at 30 and 60 Mev, performance, and utilization of the Dounreay Fast Reactor are described. The performance of the fuel handling system, control units, heat exchangers, and instrumentation are discussed. (C.E.S.)

19391 THE SGHWR PROTOTYPE REACTOR. A. Firth and J. E. R. Holmes (United Kingdom Atomic Energy Authority, Risley). Nucl. Eng., 9: 46-9(Feb. 1964).

The core design, primary circuit, fuel design, fuel handling, shielding and containment, power plant, thermal performance, stability and control, and experimental facilities of the Steam Generating Heavy Water Moderated Reactor are briefly outlined. (C.E.S.)

19392 BEHAVIOUR OF FUELS AT HIGH BURN-UP LEVELS. PART 1. FAST REACTOR FUELS. B. R. T. Frost (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Eng., 9: 55-67(Feb. 1964).

The behavior of fast reactor fuels at high burnup levels is investigated. Experimental results obtained for alloys, oxides, carbides, and dispersion fuels are presented. (C.E.S.)

19393 TREAT STUDY OF THE PENETRATION OF MOLTEN URANIUM AND U/5 wt % Fs ALLOY THROUGH TYPE 304 STAINLESS STEEL. C. M. Walter and C. E. Dickerman (Argonne National Lab., Ill.). Nucl. Sci. Eng., 18: 518-24(Apr. 1964).

Penetration rates of uranium and uranium 5 wt % fissium fuels through Type 304 stainless steel cladding were measured in the TREAT reactor using a new electrical failure-detection method. Penetration through a 0.009 in. clad takes about 1 sec in the 1100 to 1200°C temperature range. These results agree very well with out-of-pile laboratory experiments performed earlier on the same materials. This agreement indicates that the idealized, basic laboratory experiments can give reliable safety information, but that they should be substantiated by the more realistic in-pile experiments for specific applications. (auth)

19394 ECONOMICS OF REACTORS FOR POWER AND DESALINATION. S. Baron (Burns and Roe, Inc., New York). Nucleonics, 22: No. 4, 67-71(Apr. 1964).

Capital costs, fuel costs, and costs for operation and maintenance are discussed for power-desalination dual purpose power plants. (C.E.S.)

19395 ADVANCED IN-CORE INSTRUMENTATION FROM HALDEN. H. Ager-Hanssen and R. D. Smith (OECD Halden Reactor Project, Halden, Norway). Nucleonics, 22: No. 4, 49-56(Apr. 1964).

The development program for in-core instrumentation at Halden is discussed. An instrumented fuel assembly containing a burnout detector, steam sampler, central-void gage, and thermocouple is illustrated. Each component is described separately. (C.E.S.)

19396 PROBLEMS OF NUCLEAR POWER DEVELOPMENT AND THEIR RELATION TO CONVENTIONAL POWER SUPPLY. T. Kh. Margulova (Inst. of Electrical Engineering, Moscow). Teploenerg., No. 12, 6-7(Dec. 1963). (In Russian)

A review is given of various aspects of nuclear power plants and their relation to conventional power plants.

The performance of dual and single cycle operations in relation to conventional power plants is discussed. (R.V.J.)

19397 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. James Wilfred Ashley, Peter Dean Hodson, and Frederick John Rogers (to Atomic Power Constructions Ltd.). British Patent 953,320. Mar. 25, 1964. Filed June 25, 1959.

A heavy water power reactor is designed which does not require fuel enrichment or an internal calandria with sealed joints, and requires a smaller pressure vessel for a given power capacity. In this reactor, the fuel elements are located in a tube calandria in liquid heavy water moderator, and part of the moderator is boiled to form steam which is passed through the tubes to form superheated steam, which in turn is passed to a heat exchanger. (D.L.C.)

19398 HEAT EXCHANGER. (to Sulzer Frères S. A.). French Patent 1,309,016. Oct. 1, 1962. Priority date Dec. 30, 1960, Switzerland.

Heat exchangers for nuclear power plants in which the reactor coolant passes over tube banks in which the working medium is evaporated are discussed. The problem of how to arrange the tubes to get the same heat transfer rate for all tubes was considered. The tubes of a tube bank were designed of helicoïdal shape with identical pitch and were placed along a series of concentric cylinders. These tubes were interconnected in series so as to get identical tube lengths between the headers of the tube bank. These helicoïdal tubes connected in series may also be disposed in parallel with respect to the reactor coolant flow. (IIB)

19399 NUCLEAR POWER PLANT. (to Sulzer Frères S.A.). French Patent 1,321,767. Feb. 11, 1963. Priority date June 26, 1961, Switzerland.

There are some nuclear reactors in which the nuclear fuel and the coolant are enclosed in pressure tubes. In order to avoid too high temperatures of the pressure tube material, which would generally result in a lowering of the strength of the material, measures were taken for protecting the pressure tubes from the influence of the heat development in the fuel elements. These measures consist in placing a sleeve between the fuel elements and the pressure tube, so that at least a portion of the coolant flow passes through the interspace formed between the pressure tube wall and the sleeve, the sleeve consisting preferably of a moderator material, e.g., graphite. (IIB)

19400 CALANDRIA TYPE SODIUM GRAPHITE REACTOR. R. M. Peterson, J. E. Mahlmeister, N. E. Vaughn, W. J. Sanders, and A. C. Williams (to U. S. Atomic Energy Commission). U. S. Patent 3,121,052. Feb. 11, 1964.

A sodium graphite power reactor in which the unclad graphite moderator and fuel elements are contained within a core tank is described. The core tank is submersed in sodium within the reactor vessel. Extending longitudinally through the core tank are process tubes with fuel elements positioned therein. A bellows sealing means allows axial expansion and construction of the tubes. Within the core tank, a leakage plenum is located below the graphite, and above the graphite is a gas space. A vent line regulates the gas pressure in the space, and another line removes sodium from the plenum. The sodium coolant flows from the lower reactor vessel through the annular space between the fuel elements and process tubes and out into the reactor vessel space above the core tank. From there, the heated coolant is drawn off through an outlet line and sent to the heat exchange. (AEC)

Process Heat Reactors

19401 (ORNL-TM-587) A PRELIMINARY STUDY OF FUEL FABRICATION COSTS FOR LARGE HEAVY-WATER-MODERATED REACTORS. A. L. Lotts and D. A. Douglas, Jr. (Oak Ridge National Lab., Tenn.). Apr. 1964. Contract W-7405-eng-26. 43p.

The purpose of this limited study was to estimate the cost of fabricating fuel elements for very large process heat reactors intended for desalination of seawater. In concept, the reactor would be moderated by heavy water, cooled by light water, and fueled by natural uranium. The special case of using plutonium and depleted uranium as the fuel was also considered. The fuel elements were envisaged as being of the concentric-tube, Zircaloy-clad type, containing either vibratorily compacted natural UO_2 or 99.4% depleted UO_2 spiked with 0.6% PuO_2; costs were estimated for three reactor sizes: 3500, 25,000, and 100,000 Mw(t). Fabrication plants were conceived, operational methods were established, processing times and labor were estimated, and the future cost of Zircaloy was predicted. From this analysis the cost of natural-uranium fuel fabrication, not including uranium or UO_2 costs, was estimated to be $15.55, $9.62, and $5.35 per kilogram of uranium for 3500-, 25,000-, and 100,000-Mw(t) reactors, respectively. The cost of PuO_2-UO_2 fuel fabrication, including all operations from sol-gel-produced oxide to finished elements but not including plutonium, uranium, or PuO_2-UO_2 costs, was estimated, per kilogram of uranium plus plutonium, to be $19.83, $12.15, and $6.30, respectively. (auth)

19402 NUCLEAR POWER FOR SALT WATER CONVERSION. Intern. At. Energy Agency Bull., 6: No. 2, 3-7 (Apr. 1964).

Various purification processes for salt water using reactor and conventional heat and electrical sources are described. Flash distillation, vapor compression, and electrodialysis are discussed. The relative merits of mixed installations that produced electricity as well as purified water are considered. (R.E.U.)

19403 AN ASSESSMENT OF LARGE NUCLEAR POWERED SEA WATER DISTILLATION PLANTS. (Task Group on Nuclear Power and Saline Water Conversion). Mar. 1964. 41p. $0.35(GPO).

A memorandum summarizes the findings, conclusions, and recommendations of the Task Group, and a report of the interagency subcommittee is presented. The studies indicate that water prices attainable using stations made up of 8,300-Mw(t) dual-purpose reactors are 23¢ per 1,000 gal when all the plant complex is financed at a 7% fixed charge rate, or 28¢ per 1,000 gal when the reactor and water plants are financed at 14 and 7% fixed charge rates, respectively. The cost for irrigation appears to be 11¢ per 1,000 gal. Water conveyance costs are considered. It is emphasized that a station analysis for a specified proposed station would be required to determine the most practical plant. The research and development program required for dual-purpose reactor stations producing from 10 up to 620 mgd is described. The status of nuclear reactor technology and sea water distillation plants is examined. Desalting processes other than distillation are discussed briefly. (D.L.C.)

19404 APPARATUS FOR HEATING AN UNDERGROUND FORMATION. Manley L. Natland (to Richfield Oil Corp.). U. S. Patent 3,127,319. Mar. 31, 1964. Filed Feb. 8, 1957.

A compact reactor was designed for heating a subsur-

face oil-bearing stratum. The reactor uses the relative position of the fuel and moderator to control the reaction. Three embodiments of the reactor are described. (D.L.C.)

Propulsion and Space

19405 (APEX-445) FIRST MELTDOWN EXPERIMENT — FINAL REPORT. (Operation Boot). R. E. Baker, C. C. Gamertsfelder, and R. F. Gentzler (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 2, 1959. Contracts AF33(600)-38062 and AT(11-1)-171. 126p.

An experiment is described which was conducted to determine the extent of damage to a high performance aircraft type reactor and the degree of radiological hazard that resulted from airborne fission products released as a consequence of severely restricting coolant air. The facility, field sampling network, conduct of the experiment, and results are covered. Release fractions of fission products, reactor damage, radiological hazards, and the prediction of the distribution of airborne activity using meteorological diffusion theory are discussed. (auth)

19406 (CEND-169) THE UNIFIED MODULAR PLANT. A COMPACT NUCLEAR STEAM GENERATOR FOR MARINE APPLICATION. P. C. Zmola, W. S. Flinn, R. J. Rickert, G. V. Notari, and R. H. Young (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Dec. 1962. Contract AT(30-1)-3061. 70p.

A conceptual design of a compact, demand controlled, maritime reactor plant is presented. Reactor operation without the use of control rods is featured. The economics of application to a tanker are discussed. (auth)

19407 (NAA-SR-8419) SNAP-2 RELIABILITY PROGRAM. D. S. Burgess (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 31, 1963. Contract AT(11-1)-Gen-8. 29p.

The basic concept of the SNAP 2 reliability program is discussed. The basis for the reliability requirements for SNAP 2 is presented, and the fundamental methods by which these requirements can be accomplished are described. The reliability objectives for the system, a description of basic failure characteristics, and design considerations for reliability margins and component selection are presented, together with test plans for establishing reliability margins and for demonstrating system reliability. (auth)

19408 (NAA-SR-Memo-9160) MEASUREMENT OF SNAP-10A SNAPTRAN KINETICS PARAMETERS BY REACTOR NOISE TECHNIQUES. R. L. Randall and G. R. Grayban (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 11, 1963. Contract [AT(11-1)-Gen-8]. 28p.

The magnitude of the reactor transfer function was measured over the frequency region from 10 to 80,000 cps using noise analysis techniques. Graphs of the transfer function revealed the presence of three break frequencies, indicating the effects of reflected neutron kinetic behavior. A simplified theoretical derivation of the spectral density function of high frequency reactor noise is presented for a source-free, two-region (core and reflector) critical reactor with the detector in the reflector. A curve fitting code was used to compare the data to the equation representing the transfer function of the theoretical two-region reactor kinetics model. The values of the three break frequencies obtained from the computed best fit to the experimental data were 1148, 10330, and 85,177 radians/sec, corresponding to reactor system time constants of 871, 96.8, and 11.7 μsec, respectively. Simultaneous solution of the equations associated with the three break frequencies, gave values for the neutron fractions and the lifetimes. (auth)

19409 (NAA-SR-Memo-9332) NAA PROGRAM DESCRIPTION — SEPARATE SOURCE PUMP CODE. J. A. Hessler (Atomics International Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 1963. Contract AT-11-1-GEN-8. 34p.

This code computes the optimum magnetic flux for separate source pumps of specified dimensions and specified outputs (flow rate and pressure head). For this magnetic flux the code computes the current and power required and the magnet weight. The hydraulic pressure loss in the pump is also computed. (auth)

19410 (NAA-SR-Memo-9539) THERMAL ANALYSIS OF AN ANODIZED REFLECTOR FOR SNAP-2. G. E. Dufoe (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 18, 1964. Contract AT-11-1-GEN-8. 7p.

Anodization of the SNAP reflector for the 125 kw, 1300°F design point results in a reflector temperature of 760°F. By comparison the reflector temperature for the 53 kw, 1200°F design point with no anodization was 795°F. (auth)

19411 (RT/ING(63)-19) STUDIO DELLA DINAMICA DI UN REATTORE PRESSURIZZATO AD UNITA INTEGRALE PER PROPULSIONE NAVALE. (Study of the Dynamics of a Pressurized Reactor as Integral Unit for Naval Propulsion). E. Gilardi and L. Cimorelli (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). July 1963. 50p.

The dynamic behavior of an integrated, pressurized-water reactor with natural circulation was investigated both by analog computer techniques and a simplified analytical approach. Hydraulic instabilities due to the core or riser were considered, as well as overall stability and problems arising from heavy sea conditions. (auth)

19412 MEASUREMENT OF TEMPERATURE FIELDS IN THE SHIELD OF THE VVR-M REACTOR. K. A. Konoplev and R. G. Pikulik. At. Energ. (USSR), 16: 68-9(Jan. 1964). (In Russian)

The biological shield of the VVR-M reactor consists of a 210-mm thick cast iron layer, which serves as the thermal shield surrounding the core, and of concrete. The cooling air passes between the thermal column and housing and also between the reactor vessel and the cast-iron shield. In order to measure the temperature fields generated within the shield, thermocouples were spot-welded to the metal and were placed within the graphite at various locations. The measurements were carried out both with the reactor in shutdown condition and after operating it for several days at 10 Mw. The temperature distribution curves exhibited a maximum at the level of the core axis. The shield temperature was found to depend only slightly on the azimuthal distance; this was due to the fact that the core is shifted toward the thermal column which represents the hottest point in the system. The temperature decreases suddenly while passing from the cast iron to the concrete shield. The hottest point in the cast iron was found to be 49°C. The graphite temperature varied in direct relation with the reactor power level. (TTT)

19413 FOR–REACTOR FOR THE GERMAN ATOMIC SHIP. M. Von Zur Muehlen and W. Wiebe. Atomwirtschaft, 9: 61-5(Feb. 1964). (In German)

An advanced pressurized-water reactor (FOR) was chosen for a research ship for studies of nuclear propulsion for

merchant vessels. It was necessary that the reactor be compatible with a secondary plant previously ordered and attain 10,000 shp. The design of the reactor is described and shown in a diagram. (M.C.G.)

19414 EXPERIMENTAL STUDIES OF ROLLING EFFECTS ON MARINE BOILING WATER REACTORS. (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo). Ishikawajima-Harima Giho, No. 14, 584-96(Nov. 1963). (In Japanese)

The effects of rolling on the hydrodynamic behavior of natural-circulation boiling-water reactors were previously investigated experimentally using a test channel, which simulated a channel of the reactor. These data were fed into an analog computer with nuclear feedback circuits, and the influence of inclination and rolling on reactor characteristics was analyzed. Little difference was observed between inclined and vertical positions under static conditions. The stability margin is sufficiently large at 30° inclination and full power. The effect of rolling, which is 2 to 4 times greater than the effect of inclination, cannot be estimated from the vertical component of the rotational acceleration alone. The effect of rolling is generally smaller than the effect of the vertical acceleration due to normal ship motions and can be neglected provided the rolling and vertical motion are not combined. When they are combined, the reactor parameters may vary considerably and nonlinearly. Although this effect is small enough to be neglected in present designs, it would have to be taken into account in the design of more advanced high-efficiency reactors. (NSA of Japan)

19415 NUCLEAR REACTORS FOR ROCKET SPACE PROPULSION. Bruno Coppi and Corrado Casci (Istituto di Fisica Tecnica e Macchine Politecnico, Milan). Missili, 4: No. 6, 13-38(Dec. 1962). (In Italian)

Employing nuclear reactors as thermal sources for heating rocket propellants, it is possible to achieve higher specific impulses than those currently obtained through chemical combustion. Thermal, mechanical, and nuclear features of possible materials are examined. A compromise between low values of the specific mass and relatively low investment in fissionable material indicates that epithermal reactors should be the most suitable for rocket propulsion. The main problems connected with the criticality calculations, radiation shielding, and the choice of propellant are briefly discussed. The principal difficulties that make impossible at present the realization of liquid core reactors are shown. The main features of the Kiwi series reactors are presented. On the basis of the difficulties realized and the results obtained, possible future developments of the research in this field are discussed. (auth)

19416 THE 630 A MARINE REACTOR. Nucl. Eng., 9: 50-3(Feb. 1964).

The general design of the 630 A, a marine propulsion reactor, is outlined. The reactor-shield plug unit, control system, blowers, boiler, and shielding are described. Maintenance, safety, and alternative configurations are also discussed. (C.E.S.)

19417 CLOSED-LOOP DYNAMICS OF NUCLEAR ROCKET ENGINES WITH TOPPING TURBINE DRIVE. Harold P. Smith, Jr. (Univ. of California, Berkeley). Nucl. Sci. Eng., 18: 508-13(Apr. 1964).

A previous work on the closed-loop dynamics of nuclear rocket engines with bleed turbine drive is modified to study the engine dynamics using a topping turbine system. Root locus considerations show that the response characteristics of the two engine systems should be similar, although the topping turbine system has a faster initial response but slower asymptotic response. These conclusions are corroborated by analog simulation of the non-linear dynamic equations. (auth)

19418 ATOMIC SUBMARINES. Norman Polmar. Princeton, N. J., D. Van Nostrand Company, Inc., 1963. 296p. $6.95.

A summary of the history of submarines and the development and operation of nuclear-powered submarines is presented. (C.E.S.)

19419 PRESSURIZED WATER REACTOR INSTALLATION. (to Reactor Centrum Netherland). French Patent 1,311,719. Oct. 29, 1962. Priority date Jan. 26, 1961, Netherlands.

Some pressurized-water reactors have vertical fuel elements and the pressurized water passes through the reactor core and the heat exchanger in a closed cycle in order to remove the heat development in the reactor. Generally the entire quantity water passing through the reactor core also passes through the heat exchanger. Means were developed for inducing a supplementary water circulation, so that this latter circulation forms a closed cycle within the reactor pressure vessel so that hot spots, which may arise on fuel elements with the highest neutron flux, may be prevented. This disposition may be especially advantageous for nuclear power installations for ship propulsion. The means comprises at least one injection pump feeding water from the heat exchanger to injection nozzles disposed within the reactor vessel, e.g., in front of the core bottom so that the injected water provokes a supplementary upwards circulation through the reactor core. (IIB)

19420 NUCLEAR REACTOR FOR A RAILWAY VEHICLE. Lyle B. Borst (to Univ. of Utah). U. S. Patent 3,127,321. Mar. 31, 1964. Filed Apr. 7, 1955.

A homogeneous reactor is designed for use as a mobile power plant, e.g. for the propulsion of a railway vehicle. The reactor core or fuel chamber is in the shape of a right circular cylinder with an axial length-to-diameter ratio of less than 0.75, and the circular end portions serve as tube sheets for a multiplicity of small diameter cooling tubes. A catalytic recombiner for the dissociated gases is provided, and the pressure of the dissociated gases and fission gases is used in the circulation of the fuel (uranyl sulfate solution). The reactor is located in a secondary shield filled with a high-viscosity hydrogenous liquid. (D.L.C.)

19421 NUCLEAR REACTORS. John Alan Dodd (to United Kingdom Atomic Energy Authority). U. S. Patent 3,127,322. Mar. 31, 1964. Priority date Dec. 15, 1958, Great Britain.

A secondary heat exchanger apparatus is designed for removing fission product heating from a shutdown gas-cooled marine reactor. The apparatus comprises a small heat exchanger, valved ducting connecting the small exchanger with the main heat exchanger, and a header tank for supplying heat exchange fluid to the small exchanger. The small exchanger is disposed above the core for establishing coolant flow by thermosyphoning, and the header tank in turn is at a level above the small exchanger. Thus, even if the reactor was tilted, such as in heeling of a ship, shutdown heat would still be removed. (D.L.C.)

19422 SHIELDING FOR NUCLEAR REACTORS. Donald T. Bray, Archie M. Larson, Jr., Melvin J. Kornfeld, and Carl F. Leyse (to Internuclear Co.). U. S. Patent 3,127,323. Mar. 31, 1964. Filed Oct. 31, 1957.

A gas-cooled reactor for use in ship propulsion is de-

signed with a biological shield which allows access to the control rod drive mechanisms, pressure vessel head, etc., and which facilitates direct fueling and refueling. The biological shield, which is located above the core and has holes for control rods and fuel elements, comprises alternating layers of steel and graphite. A reactor using the biological shield is described in detail. (D.L.C.)

Research and Test Reactors

19423 (AECL-1881) REPAIRS TO NRX CALANDRIA TUBE H-14. D. K. Marshall (Atomic Energy of Canada Ltd. Chalk River Nuclear Labs., Chalk River, Ont.). Dec. 1963. 51p.

A helium leak detected on July 7, 1963, was traced to three small holes about 5 in. down from the top of the calandria tube. Polyethylene coned plugs were expanded in both ends of the tube to seal it off and temporarily stop the leak, but the plugs failed after 2½ hr of operation. The H-14 biological and thermal shields were then drilled out to 2½ and 2 23/64 in., respectively, to permit installation of permanent mechanical plugs in each end of the tube. The permanent plugs were successfully installed on July 28, 1963. (D.C.W.)

19424 (AERE-M-1330) A RAPID-INSERTION CONTROL-ABSORBER MECHANISM FOR USE IN HOLLOW FUEL ELEMENTS. E. S. F. King (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Feb. 1964. 17p.

A description is given of the engineering design and performance of a rapid-insertion control-absorber mechanism, for use within hollow, vertical, fuel elements of the DIDO class materials-testing reactors operating at a thermal flux of 10^{14} n/cm^2-second. The initial downward acceleration of the absorber is that of gravity, and the full travel of 24 in. takes 0.4 seconds. The magnet release time is 5 milliseconds. The absorber weighs 15 lb, has an effective area of 120 in.^{2} of cadmium, and controls nearly 3% of reactivity. It can be positioned with an accuracy of 1.5×10^{-3} in. and withdrawn at speeds of 0.016 in./sec and 0.004 in./sec. The mechanism consists of a vernier stepping motor which drives a lead-screw and raises or lowers a close-fitting cylindrical shield plug carrying at its lower end an electromagnet which supports a tubular absorber. There are large radial clearances around the absorber, which falls freely when released, except for the viscous drag of the moderator/coolant, until brought to rest by a stop on a central rod passing through the lead-screw to a ring-spring shock-absorber at the top of the mechanism. After the control absorber has been dropped, the shield plug is motored down at fast speed to re-engage it. The size of the absorber system is within the overall dimensions of the fuel element and it may be removed from the reactor by means of the fuel-unloading flask. (auth)

19425 (HW-78080) ZIRCONIUM CONCENTRATION MEASUREMENTS IN THE PRTR PRIMARY COOLANT: INTERIM REPORT, DECEMBER 8, 1962–JUNE 30, 1963. T. F. Demmitt (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 1963. Contract AT(45-1)-1350. 20p.

The total zirconium concentration in the Plutonium Recycle Test Reactor primary coolant is measured routinely to determine when fretting corrosion of Zircaloy-2 components occurs. The analytical procedure used; the concentration data obtained through June 1963; and the implications of these results with respect to observed fretting corrosion attack are discussed. (auth)

19426 (HW-80158) IN-REACTOR MONITORING OF ZIRCALOY-2 PRTR PRESSURE TUBES, PART III. JULY 1963–NOVEMBER 1963. P. J. Pankaskie (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1963. Contract AT(45-1)-1350. 25p.

From July 1962, through November 1963, all Zircaloy-2 pressure tubes in all 85 process channels of the PRTR were inspected at least once, and a few were inspected several times. These inspections showed that approximately 1700 new fretted areas formed in the pressure tubes. There are now approximately 3200 fretted areas in all tubes in the PRTR. An increase in fretted areas associated with the fuel element end bracket spacers appears to be roughly proportional to the number of times fuel elements were charged into each pressure tube. During this reporting period, there was a significant increase in the number of fretted areas associated with single fuel rod wire wraps as compared to the number associated with end bracket spacers. There was no observable fretting corrosion associated with the circumferential fuel bundle bands on the Al-Pu or mixed oxide type fuel elements. Enlarging the contact area of the end bracket spacers from ~1.5 × 12.5 mm (~1/16 × ½ in.) to ~6 × 12.5 mm (~¼ × ½ in.) significantly reduced the severity of tube wall penetration by fretting. In no case did penetrations, associated with enlarged pads, exceed 0.025 mm (0.001 in.). There is some reason to believe that end bracket spacer pad enlargement also caused a decrease in severity of fretting associated with single rod spiral wire wraps but apparently had no effect on incidence. Five pressure tubes were discharged during this reporting period. Two of these five were discharged because of suspected defects with depths of ~½ mm (~0.020 in.) or greater. (auth)

19427 (IOI-259) THE NRU REACTOR (1964). A General Description. R. E. Manson (Atomic Energy of Canada Ltd. Chalk River Nuclear Labs., Chalk River, Ont.). Jan. 1964. 211p. (AECL-1897)

The NRU reactor was shut down in November 1963, for conversion from natural uranium fuel to fully enriched fuel. The converted reactor will operate at about 60 Mw instead of 220 Mw, but the thermal neutron flux will remain approximately the same. Some modifications not related to the conversion are also being made. The reactor as it will be after the conversion is described. (auth)

19428 (IS-760) ENGINEERING DESIGN CONSIDERATIONS FOR A LIQUID-METAL IN-PILE LOOP. David Henry Thompson, Glenn Murphy, and Ray W. Fisher (Ames Lab., Ames, Iowa). Nov. 1963. Contract W-7405-eng-82. 83p.

Results are presented of an analytical investigation in the areas of fission-product activity, heat transfer, and materials for the preliminary planning of a high-temperature circulating-liquid-metal-fuel in-pile loop. Equations for the fission-product numbers and activities in a circulating fuel were derived from equations existing in the literature for the growth and decay of fission products resulting from one reactor operation and shutdown cycle. These equations were derived for continuous loop irradiation and for the more realistic loop irradiation in a reactor operating on a periodic cycle. The properties of several liquid-metal fuels were calculated and the fission-product activities in these fuels were determined for both the continuous and noncontinuous modes of reactor operation. Gamma heat effects on the in-core loop section geometry and the suitability of commercial high-temperature thermal insulation for in-pile loop application were investigated. Calculations pertaining to the out-of-pile portion of the loop

were limited to the determination of thermal stress in the heat exchanger and the effect of coolant flow conditions on the required length of the heat exchanger. The saturated fission-product activity in the liquid-metal fuels would be approximately 2,940 curies per kw of loop fission power and the corresponding activity at one year following two years of continuous fast-neutron irradiation would be approximately 53 curies per kw of loop fission power. Contributions to the total fuel activity from the fuel components and fissionable nuclides produced by radiative capture are small except in dilute fuels. Gamma heating in the in-core pressure tube cannot be satisfactorily removed by conduction and radiation in a gas-filled annulus. The in-core loop section will require a cooling system separate from the circulating fuel that could also be used to provide loop heating during reactor shutdown periods and a means of detecting primary system failure. Because the liquid-metal exchanger can be built compactly, the size of the liquid-metal loop is dependent on the size of the pump and other necessary auxiliary components. (auth)

19429 (JAERI-1056) CONCEPTUAL DESIGN OF THE JAPAN MATERIALS TESTING REACTOR. (Japan Atomic Energy Research Inst., Tokyo). Mar. 1964. 286p.

The conceptual design of the 50-Mw, water moderated and cooled reactor is given. The reactor will use highly enriched uranium and will have irradiation facilities with neutron fluxes of more than 10^{14} cm^{-2} sec^{-1}. The cooling systems, instrumentation and control, critical facility, hot laboratory, buildings, and safety analysis are covered, as well as the mechanical, nuclear, and thermal design. (D.C.W.)

19430 (ORNL-3574) SOME MAJOR FUEL-IRRADIATION TEST FACILITIES OF THE OAK RIDGE NATIONAL LABORATORY. D. B. Trauger (Oak Ridge National Lab., Tenn.). Apr. 1964. Contract W-7405-eng-26. 117p.

Irradiations of test fuel specimens and experimental fuel elements are conducted both in capsules and in forced-convection-cooled loops. The design of equipment suitable for irradiation tests pertinent to the development of boiling- and pressurized-water, gas-cooled, sodium-cooled, and molten-salt reactors is described briefly, with particular emphasis on test capability. The capsules utilize thermal conduction through sodium or NaK, gas-filled annuli, and graphite for heat removal from the fuel element surface. Six basic designs have been employed, with many variations, in conducting over 125 separate irradiation experiments. Capsule features include external pressurization to 900 psia, sweep gas for fission-gas removal, fission-gas sampling and daughter-trap collection for gamma-ray spectrometer analysis, continuous flux monitoring and control, and measurement of temperatures up to 4000°F. The loop facilities described are: (1) a pressurized-water loop for operation up to 2500 psia and 625°F with heat removal up to 300 kw; close control is provided over water chemistry; (2) two helium-cooled loops capable of operation up to a gas temperature of 1500°F, a system pressure of 300 psia, and fission and gamma heating of 60 kw; other coolants can be accommodated, and the loops are designed to operate with fission-product contamination when necessary; (3) a compact loop design for recirculating molten-salt fuels at high temperatures. Design features to meet safety requirements, alteration of equipment to accommodate changing program needs, and factors affecting the economics of operation are discussed briefly. The close relationship needed between the irradiation test laboratory and fuel development programs is indicated. The usefulness of assistance from other related groups in a large laboratory complex is mentioned. Finally, shop facilities are described for meeting the exacting needs of irradiation capsule assembly. (auth)

19431 (ZFK-RN-21) BESTIMMUNG DER STRAHLENFELDER IN DEN BESTRAHLUNGS-KANÄLEN DES ROSSENDORFER FORSCHUNGSREAKTORS. (Determination of Radiation Field in the Irradiation Channels of the Rossendorf Research Reactor). Wolfgang Suckow (Germany. Zentralinstitut für Kernphysik, Dresden). Sept. 1963. 37p.

The distribution of neutrons and gamma rays in the irradiation channels of the Rossendorf Research Reactor was measured. Thermal, epithermal, and fast fluxes were determined. The Cd ratio for several channels was also determined. The measurements of absolute values of the thermal and epithermal neutron flux were performed with Au foils. The fast flux was measured with S tablets. The relative values of thermal and fast flux were measured with wires of Cu and Al, respectively. The gamma dose power was determined by means of cerium sulfate dosimeters of different concentration. The influence of neutrons on the dosimeter was estimated. For each irradiation channel, the local distribution of radiation components is plotted. The maxima absolute values are tabulated. (auth)

19432 (AEC-tr-6382) INSTRUMENTATION IN THE 1- AND 10-MW TEST LOOPS OF RAPSODIE. N. Lions [France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Cadarache]. Translation of paper presented at the ["Colloquim of the European Society of Atomic Energy, on Liquid Metal, Aix-en-Provence, Cadarache, France, September 30 to October 2, 1963."] 37p.

The principal measuring instruments operating in the presence of liquid metal, which have been designed and developed in the Liquid Metals Division during the last few years, are electromagnetic flowmeters, differential manometers, and level indicators. Presented are the results obtained during their testing in the 1 and 10 MW test loops as well as the information derived for their utilization in the Rapsodie reactor. (auth)

19433 EXPERIMENTAL STUDY OF THE FLUCTUATIONS OF A PULSED REACTOR. Lyui Min', E. P. Shabalin, and Yu. S. Yazvitskii. At. Energ. (USSR), 16: 12-16(Jan. 1964). (In Russian)

The statistical fluctuations of the number of neutrons formed in a single fission event and of the branching of the chain reaction process, which cause corresponding fluctuations in the bursts of the pulsed reactor, may affect the control mechanism of the reactor and must be therefore carefully examined. The burst intensity distribution of the IBR pulsed reactor of the Joint Institute for Nuclear Studies was studied, using a scintillation counter placed 7 m above the core; the counter was used to record both fast neutrons and γ rays. The measurements were carried out at 6 power levels between 30 and 1200 watts. It was found that the apparatus-controlled component of the amplitude distribution dispersion does not distort the general character of the dependence of the burst intensity on the average power level. The power level values determined in these experiments were found to agree well with data calculated on the basis of the heat generated in the core. Measurement of the dispersion of the burst intensities represents a useful tool for determining the physical characteristics of this type of reactor; in particular, the average power level of the IBR reactor in the 200-watt level could be determined with an average error of 20- to 30%. (TTT)

19434 RESEARCH AND TEST REACTOR LOAD GROWS. Atomics, 17: 11-12(Mar.-Apr. 1964).

Efforts toward the design and operation of research reactors for maximum use are discussed. Specific reactors as well as general types are emphasized in research and development programs. (R.E.U.)

19435 DESIGN AND CONSTRUCTION OF JRR-4. Tatsuo Yatsurugi and Tadashi Hara (Japan Atomic Energy Research Inst., Tokyo). Genshiryoku Kogyo, 9: No. 9, 49-53 (Sept. 1963). (In Japanese)

The design features and construction schedules of JRR-4 (Japanese Research Reactor No. 4), which is under construction at Tokai-mura, are outlined. The reactor is a swimming-pool type of 1000 kw (maximum 3000 kw) and 1×10^{13} n/cm^2 sec. It is planned primarily for investigations of bulk shielding for power reactors, particularly those for nuclear powered ships. A core tank is provided to lower the radiation level of the water in the pool. A pure hot water layer in the upper part of the tank, which is ~150 cm high and 5°C hotter than the primary coolant, isolates the primary coolant water from the pool water. The core tank is made of 1.2- and 2.0-cm-thick and 10 m-high Al plates and consists of an upper annular cylinder of 150 cm dia and of a lower square cylinder (75 × 80 cm). Each fuel element contains 166 g of ^{235}U and is composed of 15 flat plates formed from 90% enriched U–Al alloy. Twenty elements are expected to be loaded into the core at full power. Reactivity is controlled by the use of a regulating plate with reactivity worth 19% ΔK/K, 4 shim plates with 0.5 ΔK/K, and 2 emergency scram plates. The pool is lined with Al plates 10 mm thick. The inside concrete shield wall is 7 × 17.5 × 10.3 m high (water depth 9.8 m) and is divided into one pool 7 m long and another pool 9 m long by a gate. The cooling method is a forced-circulation type, and the primary cooling system has a flow rate of 5.4 m^3/min. Facilities for experiments on the scattering of neutrons and γ rays from the reactor core are included. Excavation began in April 1962. JRR-4 will go critical in October 1964, and experiments will begin about Spring 1965. (NSA of Japan)

19436 OAK RIDGE RESEARCH REACTOR FOR ISOTOPE PRODUCTION. J. J. Pinajian. Isotopes Radiation Technol., 1: No. 2, 130-6(Winter 1963-64).

The Oak Ridge Research Reactor and its associated facilities are described. The ORR has a maximum flux of 5×10^{14} neutrons/cm^2 sec. Its facilities for irradiation include three removable stringers, a fast-flux stringer, the ^{131}I assembly, a hydraulic tube facility, and a pool irradiation facility. (M.C.G.)

19437 INTERCOMPARISON OF FAST-NEUTRON FLUX MONITORS IN A HOLLOW FUEL ELEMENT IN PLUTO. D. M. Clare, W. H. Martin, and B. T. Kelly (United Kingdom Atomic Energy Authority, Culcheth, Lancs, Eng.). Nucl. Sci. Eng., 18: 448-58(Apr. 1964).

An experimental comparison was made in a hollow fuel element in PLUTO of a number of possible fast-neutron flux monitors with the object of providing such a flux monitor for irradiations in very high flux materials-testing reactors. If 107 mb is adopted as the reference fast-neutron activation cross section of ^{58}Ni, the fast-neutron activation cross sections for the reactions ^{54}Fe(n,p)^{54}Mn and ^{46}Ti(n,p)^{46}Sc are found to be 73 and 8 mb respectively. It is concluded from this experiment that the ^{54}Fe(n,p)^{54}Mn reaction using iron enriched to 95% ^{54}Fe will be an adequate long-half-life fast-neutron flux monitor for irradiation in the high-flux facilities such as those likely to be used in, for example, BR-2. (auth)

19438 DETERMINATION OF FAST-NEUTRON DOSE BY NICKEL ACTIVATION. W. H. Martin and D. M. Clare (United Kingdom Atomic Energy Authority, Culcheth, Lancs, Eng.). Nucl. Sci. Eng., 18: 468-73(Apr. 1964).

Fast-neutron dose measurement by the activation of nickel foils involves a correction for thermal-neutron burnup of ^{58}Co, the daughter product of the (n,p) reaction. Fast-neutron irradiation of nickel produces ^{58}Co in its ground and excited isomeric states, and recently the isomer was shown to have a high thermal-neutron-absorption cross section. Consideration is given as to how the determination of fast-neutron dose by nickel activation should be corrected for thermal-neutron burnup of both ground and isomeric states of ^{58}Co. Results, which were fully corrected, are compared with results obtained at low reactor power where the thermal-neutron burnup of ^{58}Co and ^{58m}Co is negligible. All the data considered were obtained from foils irradiated in rigs in hollow fuel elements in reactors of the DIDO type. The data demonstrate that accurate fast-neutron dose measurements, using nickel activation, in high-flux facilities can only be made if the thermal-neutron cross sections of ^{58}Co and ^{58m}Co and the branching ratio of the ^{58}Ni(n,p) reaction are previously determined in the neutron spectrum being utilized. (auth)

19439 MEASUREMENTS OF LEAKAGE-NEUTRON ENERGY SPECTRA. C. A. Anderson, Jr., and T. J. Thompson (Massachusetts Inst. of Tech., Cambridge). Nucl. Sci. Eng., 18: 474-80(Apr. 1964).

Energy spectra of neutrons leaking from the core tank of the Massachusetts Institute of Technology heavy-water-moderated reactor were measured with a fast neutron chopper. The energy range 2×10^{-3} to 2×10^{5} ev was examined for three different fuel configurations. The spectra are fairly well described as the sum of a Maxwell-Boltzman distribution and a dE/E slowing-down distribution. The energy resolution, ΔE/E, is less than 5% at energies below 100 ev and varies as $E^{\frac{1}{2}}$ above 100 ev, while the probable error in current, ΔJ/J, is less than 10% at all energies. (auth)

19440 NITROGEN-17 DECAY MONITORS REACTOR POWER. A. M. Plummer (Battelle Memorial Inst., Columbus, Ohio). Nucleonics, 22: No. 4, 84-5(Apr. 1964).

To reduce inaccuracies in power monitoring, a monitor was installed in the Battelle Research Reactor to detect neutrons emitted as a result of the decay of ^{17}N produced by an (n,p) reaction on ^{17}O in the coolant water as it passes through the reactor core. Unstable ^{17}N decays by beta emission to an excited state of ^{17}O which, in turn, emits a neutron. (C.E.S.)

19441 HEALTH PHYSICS EXPERIENCE AT THE 1-Mw POOL REACTOR, FRM. M. Oberhofer (Technische Hochschule, Munich). Res. Reactor J., 4: No. 2, 6-10 (1963-64).

Some incidents involving more or less serious radiation danger or reactor hazard recorded at FRM from Oct. 1958 to 1961 are described. (R.E.U.)

19442 PULSTAR—THE AMF PULSING REACTOR. John MacPhee and John F. Wett (AMF Atomics, New York). Res. Reactor J., 4: No. 2, 12-19(1963-64).

A description is given of the reactor core of Pulstar. The fuel assemblies of the 5-Mev research reactor consist of 25 pin-type fuel elements in a Zircaloy box. Each pin-type element is made of 40 UO_2 fuel pellets in a sealed Zircaloy tube. The core performance under steady-state and pulsing operations is discussed. Safety features of Pulstar are described. (R.E.U.)

19443 REACTOR WITH PROMPT NEGATIVE TEMPERATURE COEFFICIENT AND FUEL ELEMENT THEREFOR. Theodore Brewster Taylor, Andrew Wetherbee McReynolds, and Freeman John Dyson (to General Dynamics Corp.). U. S. Patent 3,127,325. March 31, 1964. Filed May 9, 1958.

A reactor having fuel elements of the solid homogeneous type (mixture of fuel and moderator) is designed which has a prompt negative temperature coefficient of reactivity and is therefore easy to control. The negative coefficient is caused by a combination of the fuel element expansion effect, warm neutron effect, leakage effect, and neutron Doppler effect. A research reactor designed to operate at power levels up to 10 kw at ~40°C is described. (D.L.C.)

WASTE DISPOSAL AND PROCESSING

19444 (HW-75223) ANALOG COMPUTER SIMULATION OF A POT CALCINER. Ray D. Benham (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 1, 1962. Contract AT(45-1)-1350. 38p.

The derivation and analog computer simulation is presented of a mathematical model of the calcination portion of the low temperature evaporation method for waste calcination. The effects of process variables on the time dependence of the radial temperature profiles were studied for pots of different geometry. The results are limited because the chemical reaction rate constants and thermal properties were estimated. Calculated heating periods (2 to 20 hr) are in agreement with literature, and the lag time between initiation of cooling and the occurrence of a hot spot is shown to be appreciable (4 to 20 hr). (D.L.C.)

19445 (HW-76973(Rev.)) DENITRATION OF PUREX WASTES WITH SUGAR. L. A. Bray (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1963. Contract AT(45-1)-1350. 25p.

A process was developed for the destruction of HNO_3 in Purex-type waste solutions using sugar. Polyhydroxy compounds such as sucrose, fructose, glucose, and crude syrups such as black strap molasses rapidly and controllably decompose HNO_3 in aqueous solutions at temperatures above approximately 85°C. The number of moles of HNO_3 destroyed per mole of sugar fed is a function of the temperature of reaction and the moles of dissolved multivalent metal cations (such as iron and chromium). The efficiency of HNO_3 destruction does not vary with acid concentration over the range of 0.5 to 8 M. However, destruction of acid does vary with iron concentration. Approximately 12 to 20 moles of HNO_3 are destroyed per mole of sucrose fed as the iron concentration increases from 0 to 1 M. Products of the denitration reaction are all gaseous, consisting of oxides of carbon and nitrogen. The process was successfully tested in the high level hot cells, the cold pilot plant denitration unit, and in the Purex plant. (P.C.H.)

19446 (HW-80686) SOLVENT EXTRACTION OF CESIUM BY 4-SEC-BUTYL-2-(α-METHYLBENZYL) PHENOL (BAMBP): PILOT PLANT STUDIES. G. L. Richardson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 3, 1964. Contract AT(45-1)-1350. 21p.

The extraction and recovery of cesium from a simulated Purex alkaline waste supernate was successfully demonstrated in the pilot plant pulse column using both a nozzle plate cartridge and Raschig ring packing. Stable volumetric capacities as high as 500 gph/ft^2, sum of flows, were obtained with the nozzle plate cartridge together with HTU's (overall raffinate-film basis) of 2 feet or less (waste losses less than 2 percent using a 9 foot extraction section). Still higher capacities were demonstrated in the pulsed, packed column but with some loss in efficiency. The cesium product was decontaminated by factors of 300 to 1400 from sodium by the use of weak, inorganic acid scrubs (such as boric or phosphoric acid) and stripped from the solvent with dilute HNO_3. The HTU's in the stripping operation were generally greater than 2 feet (optimum waste losses of 2 to 3 percent typical). The sodium decontamination factors (DF's) and cesium stripping HTU's were considerably poorer than expected. The poor performance was eventually traced to degradation of the solvent through reaction with nitrite ion entrained with the feed into acidic portions of the purification cycle. The degradation did not appear to affect cesium extraction, but it greatly interfered with sodium and cesium stripping. Addition of sulfamate ion to the stripping solutions prevented the degradation reaction. A second series of runs was made (with fresh BAMBP) to test the ability of a BAMBP extraction process to purify a conceptual cesium crude. This crude, containing 0.05M Cs, 0.01M K, and 2M Na, was decontaminated an average of 8000-fold from sodium and 800-fold from potassium. The final product was concentrated by a factor of five. Typical HTU's for both extraction and stripping ranged from 1 to 2 feet (optimum waste losses less than 1 percent) at volume velocities as high as 900 gph/ft^2 in the 1A column and 550 gph/ft^2 in the 1C column. Water was satisfactorily used to scrub sodium from the solvent prior to cesium stripping; scrub DF's averaged five for sodium and greater than 10 for potassium. Dilute sulfamic acid was used to strip the cesium; however, nitric acid (containing a trace of sulfamic acid or hydrazine as insurance against the nitrite reaction) could be used. BAMBP was proved to be a highly satisfactory, selective solvent for cesium recovery and purification, but its sensitivity to nitrite degradation may limit its usefulness in high radiation fields where nitrite ion is continuously formed by nitrate radiolysis. Evaluation of this aspect is currently in progress. (auth)

19447 (IDO-14626) ANALOG SOLUTION OF A MODEL OF THE SOURCES OF ELUTRIATABLE FINES IN THE FLUIDIZED BED CLACINATION PROCESS. Earl S. Grimmett (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Feb. 28, 1964. Contract AT(10-1)-205. 26p.

A model is proposed which depicts the sources of elutriatable fines in the fluidized bed calcination process as being in two major groups, spray drying mechanisms and attrition mechanisms. Based on this model, equations are derived which express the rate of change of the concentration of a chemical tracer material in the elutriated fines, following introduction of the tracer into the feed and following its removal from the feed. This system has been simulated on an analog computer, and by matching the computer simulation to results from an actual calciner run, the rates of generation of fines by each of the two groups of mechanisms has been determined; the same technique results in an estimate of the amount of these fines remaining in the fluidized bed. Agreement between postulated results and results of actual experimental tests lends credence to the usefulness of this analytical technique. (auth)

19448 (ORNL-TM-757) WASTE TREATMENT AND DISPOSAL PROGRESS REPORT, MAY–OCTOBER 1963. F. L. Parker and R. E. Blanco (Oak Ridge National Lab., Tenn.). Apr. 1964. Contract [W-7405-eng-26]. 192p.

Progress is reported on developments in waste treatment and disposal in terms of: high-level-waste calcination; low-level-waste treatment; engineering, economics, and safety evaluation; disposal in deep wells; disposal in natural salt formations; Clinch River study; fundamental studies of minerals; and White Oak Creek basin study. (B.O.G.)

19449 (ZFK-RCH-2) ANWENDUNGSPROBLEME EINES TORF-TON-AUSTAUSCHERS BEI DER REINIGUNG RADIOAKTIVER LÖSUNGEN. (Use of a Peat-Clay Exchanger for the Purification of Radioactive Solutions). Guenter Sachse and Reinhart Winkler (Germany. Zentralinstitut für Kernphysik, Dresden). May 1963. 23p.

From montmorillonite clays and peat was prepared a cation exchanger with stable granular structure. The selective properties of the components made the exchanger suitable for the separation of cationically existing fission products from waste waters. The raw materials for the preparation of the exchanger are cheap and easily obtainable. Therefore, it is possible to forego regeneration and reuse. (auth)

19450 (CEA-tr-A-1462) DONNEES FONDAMENTALES RECUEILLIES AU LABORATOIRE EN VUE DE LA CONSTRUCTION DE L'INSTALLATION DE TRAITEMENT DES DECHETS AU LABORATOIRE DE HAUTE ENERGIE DE L'E.I.R. A WURENLINGEN. I. TRAITEMENT DES DECHETS DE FAIBLE ACTIVITE. (Fundamental Data Collected at the Laboratory with the Object of Construction of an Installation for Treatment of Wastes at the E.I.R. High-Energy Laboratory at Würenlingen. I. Treatment of Wastes of Low Activity). Gunten. Translated into French from Neue Tech., 4: 345-403(1962). 31p.

The decontamination of slightly radioactive effluents was studied. Flocculation by $Na_3PO_4 - FeCl_2$ at a pH of 11.5, followed by ion exchange on vermiculite, gave decontamination coefficients of 300 to 500. The vermiculite in its natural state, however, appears unsuitable for use in the installation under construction. Vermiculite substituted with sodium gave the best results. (D.C.W.)

19451 (JPRS-23903) THE EFFECT OF STRONTIUM^{89} ON THE MICROFLORA OF BIOLOGICAL FILTERS. B. N. Il'yin. Translated from Gigiena i Sanit., [29]: No. 2, 102-4(Feb. 1964). 5p. (OTS-64-21915)

In deactivation of sewer water containing ^{89}Sr in a concentration of 5×10^{-7} C/l, the maximum isotope content in the biological film reached 1×10^{-5} C/kg of raw weight. This quantity of ^{89}Sr did not have any effect on the biochemical activity of heterotrophic microorganisms in a biological film and on the weight increase in it during the first 8 to 10 months of operation and did not impair the functioning of the biofilter in decontaminating sewer water. Daily introduction of ^{89}Sr in a concentration of 5×10^{-7} C/l with sewer fluid does not affect the maturation of biofilters under optimum operating conditions. ^{89}Sr in concentrations of 5×10^{-2} to 5×10^{-6} C/l did not have a marked effect on nitrifying bacteria in the biological film of the biofilter. (auth)

19452 CLARIFYING AND PURIFYING OF RADIOACTIVE WASTE LIQUIDS BY THE FLOTATION METHOD. V. V. Pushkarev, Yu. V. Egorov, E. V. Tkachenko, and V. L. Zolotavin. At. Energ. (USSR), 16: 48-51(Jan. 1964). (In Russian)

Use of Al or Fe hydroxides for the clarification of radioactive waste effluents results in the formation of bulky deposits. Tests were carried out on a method for decreasing the volume of these deposits by carrying out the purification process with the addition of a flotation agent, which renders the surface of the solid particles hydrophobic. The system studied consisted of the hydroxides and surface-active and complexing agents, added to the radioactive waste solution. The moisture content of the flotated hydroxides and the efficiency of the removal of the radioactive components, such as ^{90}Sr, ^{90}Y, and ^{95}Nb and the hardness of the solution were determined as a function of the pH, the amount of the flotation agent, and the amount of the added hydroxide. The best rate was found to be 0.002 to 0.004 ml of sulfate soap flotation agent per mg of the hydroxide. The lowest moisture content of the flotated deposit (92.0 to 95.0%) was obtained at a pH between 6.0 and 7.0; the moisture content was not affected by the amount of the flotation agent. Comparison with settling tests revealed that the flotation method yields deposits with lower moisture content and lower volume; the time needed for clarification was also considerably shorter. (TTT)

19453 THE ENCAPSULATION OF HIGH-LEVEL NUCLEAR WASTES. R. N. Rickles (Dorr-Oliver, Inc., Stamford, Conn.). Atomics, 17: 50-2(Mar.-Apr. 1964).

A variety of liquid-to-solid conversion techniques presently used in waste disposal are reviewed. Encapsulation by formation of glass directly from the liquid product and by preparing a metal matrix containing solid waste are discussed. 17 references. (R.E.U.)

19454 THE TREATMENT OF BIOLOGICALLY LOADED RADIOACTIVE SEWAGE. R. Schulze-Rettmer and K. H. Rattay (Kernforschungsanlage, Julich, Ger.). Atompraxis, 10: 74-9(Feb. 1964). (In German)

The usual systems for the treatment of biologically loaded radioactive sewage (fecal effluents of a radiological hospital) are discussed, and disgestion of the biological material prior to decontamination is described. For this purpose ordinarily biological sewage purification is indicated. Since this treatment has some disadvantage when small amounts of sewage are involved, chemical oxidation is suggested. Peroxodisulfate as an oxidant is best suited because of its effectiveness and the effluents are not toxic. (auth)

GENERAL AND MISCELLANEOUS

19455 (ANL-6820) ASYMPTOTIC SOLUTIONS TO COMPOUND DECISION PROBLEMS. John R. Van Ryzin (Argonne National Lab., Ill. and Michigan State Univ., East Lansing). Feb. 1964. Contract W-31-109-eng-38. 101p.

A compound decision problem is the simultaneous consideration of a large number of statistical decision of identical nature. The work of Hannan and Robins are extended to the derivation of optimal asymptotic procedures in the sense of regret risk convergence for a variety of compound decision problems. Convergence theorems are derived. (D.L.C.)

19456 (ANL-6840) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, JANUARY 1964. (Argonne National Lab., Ill.). Feb. 15, 1964. Contract W-31-109-eng-38. 103p.

Research and development activities are reported on Borax-V, ZPR-III No. 44, ZPR-VI No. 1, ZPR-IX, EBR-I, EBR-II, EBWR, Treat, Faret, Rapsodie Reactor, critical assemblies, fast reactors, Argonne Low Power Research Reactor, Topsy, Godiva, Argonaut Reactor, Argonne Advanced Research Reactor, Rocket Fuel Test Reactor, magnetohydrodynamic cells, and fuel cells. Reactor technology and investigations are reported in reactor physics, fuels and materials development, component development, heat engineering, and chemical separations. Nuclear safety development in thermal and fast reactors is discussed. (N.W.R.)

19457 (HASL-141) PRESELECT ADDRESS UNIT FOR THE IBM-1620 COMPUTER. J. J. Frey, R. T. Graveson, and M. E. Cassidy (New York Operations Office. Health and Safety Lab., AEC). Dec. 1963. 20p.

A device is described which permits the user to stop an IBM 1620 computer at any preselected instruction address to aid in program debugging. Computer timing considerations are discussed, and a circuit description is provided. (auth)

19458 (HW-68600-36) PLUTONIUM ABSTRACTS. Volume 4, Number 2. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1, 1964. Contract AT(45-1)-1350. 11p.

A total of 12 abstracts is presented on new developments in plutonium technology. The abstracts cover the subject fields chemistry, health and safety, metallurgy and ceramics, physics, reactor technology, and miscellaneous. (D.L.C.)

19459 (HW-80524) HANFORD FORMAL RESEARCH AND DEVELOPMENT REPORTS, 1963. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 1964. Contract AT(45-1)-1350. 37p.

A bibliography of 118 Hanford reports is presented which is arranged into the following subject categories: biology and medicine; chemistry; engineering and equipment; general; health and safety; instruments; isotopes; mathematics and computers; metals, ceramics, and materials; meteorology; physics; reactor technology; and waste disposal and processing. Author, progress report, and report number indexes are included. (D.L.C.)

19460 (HW-SA-3313) CHARACTERIZATION FOR AUTOMATIC CONTROL OF A TYPICAL CHEMICAL PROCESS. N. P. Wilburn (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 7, 1964. Contract AT(45-1)-1350. 23p. (CONF-454-1)

From Western Region Quality Control Conference, Portland, Oreg., Apr. 1964.

Characterization of a chemical process requires consideration of many engineering, mathematical, and statistical problems. A mathematical model of the process must first be obtained by theoretical or empirical means. Secondly, an experiment needs to be designed to obtain an estimation of the parameters of the model. This design is necessarily subject to economic, physical, and practical limitations. Thirdly, instrumentation is required to measure either directly or indirectly the independent and response variables of the process. The ease of calibration, ease of logging, and methods of sampling need to be considered in the design and application of the instrumentation. Finally, the analysis of the data in order to obtain the parameters of the model is required. This usually involves mathematical solution of non-linear differential equations, non-linear estimation, and problems in how to weight the data. The many aspects of the above steps which result in the characterization of a chemical process are considered in general and in particular for a typical process. (auth)

19461 (HW-SA-3420) PLANNING AND SCHEDULING MULTI-SHOP MANUFACTURING ACTIVITIES. R. H. Wheaton (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 17, 1964. Contract AT(45-1)-1350. 16p. (CONF-451-1)

From the Western Region Methods and Work Measurement Conference, Phoenix, Ariz., Apr. 1964.

The organization of Hanford Atomic Products Operation is described briefly. The role and makeup of the Central Maintenance group are described in some detail. The planning, scheduling, and control activities of the group are discussed. The forms used in work orders are described. Finally, improvement of shop facilities and tools is considered. (D.L.C.)

19462 (IS-833) FORTRAN PROGRAMS FOR THERMAL DIFFUSIVITY CALCULATIONS. Arthur H. Klein (Ames Lab., Ames, Iowa). Feb. 1964. Contract W-7405-eng-82. 20p.

Two programs were written for analysis on the IBM 7074 of thermal diffusivity data taken by a linear, finite-rod method and a radial, stacked-disk method (described). The equations are presented, and operation and compilation of the programs are discussed. The program listings are included. (D.C.W.)

19463 (LADC-5778) VIBRATIONAL ASSIGNMENT AND FORCE CONSTANTS OF S_8 FROM A NORMAL-COORDINATE TREATMENT. D. W. Scott, J. P. McCullough (Bureau of Mines. Bartlesville Petroleum Research Center, Okla.), and F. H. Kruse (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract W-7405-eng-36. 12p.

Normal-coordinate calculations for the S_8 molecule were revised by use of new far-infrared spectral data and a more elaborate potential function. Representation of the observed frequencies required that the basic Urey–Bradley field be supplemented with an extra quadratic cross-term between adjacent S—S bonds. (auth)

19464 (LADC-5780) HYDROGEN BONDING IN β-NITRO ALCOHOLS. III. PYRIDINE COMPLEXES. H. E. Ungnade, E. D. Loughran, and L. W. Kissinger (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract W-7405-eng-36. 21p.

β-Nitro alcohols form stable 1:1 complexes with pyridine, examples of which were prepared. In solvents such as dichloromethane and carbon tetrachloride the complexes partially dissociate into their components. The dissociation constants for the equilibria were determined by infrared methods and may be used as a measure of the strength of the complex hydrogen bond. The dissociation constants decrease with increasing number of β-nitro groups. Some reactions of the pyridine complexes are described. (auth)

19465 (MLM-1160) MOUND LABORATORY PROGRESS REPORT FOR JUNE 1963. J. F. Eichelberger, G. R. Grove, and L. V. Jones (Mound Lab., Miamisburg, Ohio). June 28, 1963. Contract AT(33-1)-Gen-53. 30p.

The half life of tritium was determined calorimetrically over a 1456-day period. The half life was calculated to be 12.355 ± 0.010 years, based on measurements in three calorimeters. The yields of ^{208}Po and ^{209}Po from the irradiation of multicurie quantities of ^{210}Po were calculated. Production of small quantities of ^{208}Po and ^{209}Po is possible by the (n,xn) reaction; however, large quantities of ^{210}Po would be present in the ^{208}Po–^{209}Po sample. On the basis of these calculations the maximum ^{208}Po content would occur after 466 days' irradiation in the materials testing reactor. An experimental decay scheme was drawn for ^{208}Po on the basis of experimental data. Experiments are in progress to determine whether levels at about 1.4 Mev in ^{208}Bi are populated in the electron capture decay of ^{208}Po. The known half-life method for determining the resolution time of a counting instrument was found to yield only an average value for the counting range in the computation. To correct the counting error a series of computations should be made with data covering only a short segment of the decay curve rather than a single computation covering the entire range. Alternatively, the decaying-pair method of half life determination can be used, eliminating the need for an accurate knowledge of the resolution time. A process for the separation of ^{234}U from ^{238}Pu was developed. One batch of feed solution was processed by the method, and 14 mg of ^{234}U were recovered. A second continuous solvent extraction process is being investigated. Thermogravimetric studies and the differential thermal analysis of potassium plutonium sulfate dihydrate were completed. The previously reported DTA thermogram for salt was confirmed. The existence of the complex acid $H_2Pu(SO_4)_4$ is indicated. The solubility of potassium plutonium sulfate dihydrate was determined in solutions of 0.959 M H_2SO_4 containing potassium chloride at concentrations from 0.1 to 0.5 M. The values were plotted in a straight line with a slope of 4.08, as compared to a theoretical 4.00. A thermogravimetric analysis of potassium plutonium sulfate dihydrate was completed. Thermograms of this dihydrate and of plutonium sulfate tetrahydrate indicated that a crystalline phase transformation occurs after the waters of hydration are driven off. The potassium sulfate alpha-to-beta phase transformation was absent from the dihydrate salt thermogram indicating that no free potassium sulfate was present. Two cascaded, 24-foot, hot-wire thermal diffusion columns are being used to remove heavy gaseous impurities, such as nitrogen, carbon monoxide, and ethane, from 99% pure natural methane. In a three-column series system the ^{13}C content is 7% in 89% methane at the bottom of the third stage. The first five stages of a seven-stage thermal diffusion column cascade system enriched natural methane to about 10% ^{13}C. Thermal diffusion column transport coefficients are being measured for various carbon monoxide masses, and an accurate value is being determined for the experimental hot wall temperature. An experimental system is being designed for studying the nonaqueous carbamate chemical exchange method for enriching ^{13}C. The system is expected to yield a separation factor up to 1.39, although about 100 hours is required for equilibrium. The use of alternating current for heating column center wires is being studied. A 36-inch wire was attached to a wooden frame, while the bottom of the wire was allowed to swing freely in a pool of mercury. At 48 amperes and 24 volts the wire was deflected to the side of the mercury container; a larger container lessened the deflection. A magnetic field between the lead wire and the center wire may also increase deflection. The equation describing the steady state vibrations of column wire heated by alternating current was derived. To date, the maximum amount of polonium that could be contained by electroplated gold was 5 to 10 mC/cm^2. By another procedure the maximum polonium concentration may be increased by several orders of magnitude: freshly electroplated polonium was transferred wet from the polonium plating bath to a silver strike bath and then to a gold plating bath. Experiments to confirm this increase are continuing. Two Po–Be sources prepared late in 1957 were returned from the Martin-Marietta Corporation. An alpha pulse height analysis of one source showed no peaks characteristic of ^{208}Po or ^{209}Po. A method was developed for the destructive analysis of beryllium. A dissolved beryllium sample was irradiated by an ^{124}Sb gamma source to cause a (γ,n) reaction. The neutrons activated an indium detector, which was then beta counted; the beta count rate was proportional to the neutron flux. The analysis results were an average 0.08% below values obtained by gravimetric analyses. A sample of fission product xenon containing an estimated 10^{-9} at.% ^{85}Kr was counted in the low-level counting system. The results indicated that gases containing less than 10^{-12} at.% ^{85}Kr can be detected in this system; however, krypton is adsorbed on the walls of the proportional counting chamber during an experiment; hence, a purging procedure is being developed to keep the counter background at a constant rate. (auth)

19466 (MLM-1170) MOUND LABORATORY PROGRESS REPORT FOR JULY 1963. J. F. Eichelberger, G. R. Grove, and L. V. Jones (Mound Lab., Miamisburg, Ohio). July 30, 1963. Contract AT(33-1)-Gen-53. 22p.

The thallium isotope ^{204}Tl was tentatively assigned a half life of 3.781 ± 0.010 years based on calorimetric measurements. The calorimetric assay of the sample will be continued for several years to decrease the probable error. The decay scheme for ^{208}Po–^{209}Po isotopic mixtures is being determined. The gamma spectrum is being studied using two sources of different isotopic composition. Definite peaks were established at 76, 260, 300, 575, and 910 kev. Various multiple coincidence experiments indicated that the 300- and 575-kev photons and the 76-kev x-ray are in triple coincidence. Relative intensities of the various gamma rays from the two different sources indicated that the 575-kev photon is associated with ^{208}Po decay, while the 260- and 910-kev states are attributed to ^{209}Po. A theoretical estimate of the partial alpha half life for ^{208}Po decay to the 2+ level in ^{204}Pb (at 0.899 Mev) was made. This value (2.5×10^6 years) was determined graphically by extrapolation to an alpha particle energy of 4.211 Mev. ^{208}Po–^{209}Po sources are being prepared for the investigation of the internal conversion electron spectra of these isotopes. Ion exchange techniques are being studied for the separation of ^{227}Ac from ^{227}Th, ^{223}Ra,

and ^{226}Ra. Naturally occurring lanthanum, thorium, and barium are being used as experimental substitutes. Composite elution curves indicated that lanthanum and ^{232}Th can be successfully isolated with 2 M HCl, 3 M HNO_3, and ammonium acetate as elutrients. A purified form of the original Dowex 50W-X8 column packing material was used; the new material (AG-50W-X8) reduced tailing on the elution curves. ^{229}Th was tentatively assigned a half life of 1.9132 years with an internal probable error of 0.0005 year. The presence of ^{210}Po and actinium must be positively identified in the sample by chemical analysis and alpha pulse height analyses. Mound Laboratory is studying the separation and purification of ^{234}U from aged ^{238}Pu using ion exchange and solvent extraction techniques. A batch containing an estimated 250 milligrams of ^{234}U in 26.2 grams of plutonium is being processed. The anion exchange separation procedure for this batch was completed. More than 99% of the plutonium was removed from the uranium. A spectrophotometric method is being developed for the determination of ^{234}U in samples containing aluminum, iron, and plutonium. The extraneous metallic ions were separated, and the uranium was complexed with 1-(2-pyridylazo)-2-naphthol (PAN). After the color developed, the absorbance was read at 570 mμ. Standard uranium samples were analyzed, and Beer's law was followed between 0 and 80 μg of uranium. Gram quantities of over 90% pure ^{13}C are being prepared. Various thermal diffusion column configurations are being used for separation efficiency studies and evaluation of feed gases, such as carbon monoxide or methane. The first five stages of the seven-stage cascade system of hot-wire and concentric-tube columns are enriching natural methane to about 23% ^{13}C while coming to steady state conditions. The concentric tube columns enriched methane from 60 to over 90% ^{13}C in the total carbon. About 1.5 grams of product containing about 10% impurities were accumulated. The use of alternating current for heating thermal diffusion column wires is being studied. Vibration of the wire is the major problem. Two parallel iron discs were used to align the electrical leads and the column wire in the pool of mercury; however, the discs did not prevent vibration. The mercury pool was replaced by rubber bands, and subsequently by a spring, for tensioning the wire; there was a slight vibration. A braided cable was used as an electrical lead for alternating current and as a vibration damper. Both the vibration and the use of a mercury pool were eliminated. An integral was set up to determine the error introduced into the calibration of neutron sources by the finite geometry of a source. For a source with 80 grams of plutonium, the effect of geometry gave a calibration 0.25% higher than for a point source. The ratio of room-scattered neutrons to unscattered neutrons in a counting room is being determined. An empirical expression for the ratio as a function of source-to-detector separation was revised. In the revised expression there are only two parameters as compared to three in the earlier form. Several different polonium alpha sources were prepared by different plating techniques. As base material copper received a more uniform coating than platinum. A silver strike bath on the polonium allowed a thinner, wipe-free gold plating. Rouge was substituted for scouring powder, which cut grooves in a gold plate during swaging of the plate. Experiments with a mixture of xenon containing 1.3×10^{-9} at.% ^{85}Kr and 10% methane indicated that the counting chamber efficiency is 68% and that the counter will detect 2.9×10^{-13} at.% ^{85}Kr. A study was made to verify that the counts in coincidence between the two hemispheres of the four pi beta counter are the results of cross scattering. The number of coincidences increased with the aperture size; however, the increase was not strictly linear with aperture area due to such factors as counting statistics, instrument resolving time uncertainty, and penetration of the lead holder by scattered particles. The data show that the preponderant effect of coincidence is due to cross scattering. (auth)

19467 (MLM-1175) MOUND LABORATORY PROGRESS REPORT FOR AUGUST 1963. J. F. Eichelberger and G. R. Grove (Mound Lab., Miamisburg, Ohio). Aug. 31, 1963. Contract AT(33-1)-Gen-53. 12p.

Various thermal diffusion column configurations for ^{13}C separation using methane or carbon monoxide as feed are being used to study separation efficiency. The first five stages of a seven-stage cascade system of hot wire and concentric tube columns are enriching natural methane to about 32% ^{13}C while coming to steady state conditions. The concentric tube columns enriched methane from 60 to over 90% ^{13}C. About two grams of methane were accumulated that contain about 10% impurities. Chromatography is being used to separate ^{85}Kr from xenon. The ^{85}Kr content in xenon was reduced from 10^{-5} to 10^{-8}%. The efficiency of the separation increased as the column temperature decreased. In the variational method for determining a half life and the resolution time of a proportional counting system, it was found that the assumption of a constant resolving time is valid if the dead time losses are described by a Poisson time distribution function. The reaction between lanthanum and tellurium was studied. Lanthanum tellurides prepared in aqueous media yield solid solutions, or amorphous substances convertible to solid solutions. The half life of ^{208}Po, as determined by alpha counting, was found to be 1056^{+42}_{-34} days. Counting measurements indicated that the half life of ^{209}Po has a lower limit of 55 years. (auth)

19468 (MLM-1176) MOUND LABORATORY PROGRESS REPORT FOR SEPTEMBER 1963. J. F. Eichelberger, G. R. Grove, and L. V. Jones (Mound Lab., Miamisburg, Ohio). Sept. 30, 1963. Contract AT(33-1)-Gen-53. 15p.

Three silicone-based conductive adhesives were formulated and evaluated. One of the formulations had a resistivity of 0.089 ohm-centimeter after aging one week. After the same period the other two formulations had resistivities of 0.871 and 38.0 ohm-centimeters. Erratic adsorptive behavior of ^{140}Ba was traced to an impurity in the Ba–^{140}La stock solution. Repurification by cation exchange did not improve the reproducibility of the separations, possibly because impurities are reintroduced by the distilled water. Definite improvement was noted when the ^{140}Ba was separated from ^{140}La and other hydrolyzable materials by residue adsorption methods. A calorimetric measurement of a salt sample over a period of 148 days gave a tritium half life of 12.361 ± 0.028 years. This value confirmed the earlier value of 12.355 ± 0.028 years. The ^{208}Po–^{209}Po mixture returned from Argonne National Laboratory is being processed further. Two batches of polonium-contaminated organic material were wet-ashed in nitric and perchloric acids. Further purification will be by techniques similar to those presently used for separating ^{210}Po from bismuth. An unidentified gamma activity was found in the polonium that was recovered from pieces of Monel fluorination apparatus. The optimum conditions for decontamination of polonium process waste are being determined. Ferric sulfate was dissolved in the solution, and the pH was adjusted to a value between 7.0 and 12.0 to precipitate ferric hydroxide. However, the alpha and beta

activity was not decreased sufficiently to allow dumping of the wastes without further processing. A method of separating ^{227}Ac from a mixture of its daughter products and ^{226}Ra is being developed using ion exchange and solvent extraction techniques. Substituted elements are being used to evaluate the separation procedures prior to the separation of the radioactive isotopes. More than 99% of the thorium in the separation mixture was extracted into a chloroform solution of thenoyltrifluoroacetone at pH 2. The separation of ^{234}U from aged ^{238}Pu was demonstrated using ion exchange and solvent extraction techniques. One batch of aged ^{238}Pu solution was processed, and 14 mg of ^{234}U were recovered. A second batch containing an estimated 250 mg of ^{234}U in 26.2 grams of ^{238}Pu is being processed. More than 99% of the plutonium was removed from the uranium fraction using an ion exchange technique, followed by a hexone extraction. Calibrations of neutron sources with the precision long counter are based on counting the unknown and the standard with their geometrical centers at the same position. The percentage by which the detector counting rate for a PuBe source of finite geometry exceeds the counting rate for a point-source was determined for six sources. As a result of the investigation of neutron source calibration, the relative responses of the precision long counter to PuBe secondary standard sources are being restudied. Twenty-two recanned PuBe sources were recalibrated. A new electroplating control unit is being used for plating the gold retention layer on a series of experimental polonium alpha sources. Fabrication of wipe-free, gold-plated polonium sources with a specific activity of more than five mC/cm^2 was unsuccessful. A quasi-calorimeter is being used to investigate stretching effects of calorimeters. Stretching, or tailing on the calorimeter cooling curve, is affected by the insulation used. To lower the stretching effect in micro-calorimeters an insulation consisting of an air gap, or gaps, separated by foils will be used. (auth)

19469 (NP-13707) BRIEF ANNUAL REPORT, 1963-64. (India. Dept. of Atomic Energy, Bombay). 34p.

Developments in atomic energy and space science in India in fiscal year 1963-1964 are reported. Topics covered include: physics, electronics, chemistry, metallurgy, biology, atomic power, and geology. Information is also included on: Jaduguda Mines, power and research reactors, industrial operations, international relations, Tata Institute of Fundamental Research, Thumba Equatorial Rocket Launching Station, research institutions, and publications. (N.W.R.)

19470 (NYO-2138-1) FACTORS AFFECTING PLATELET PRODUCTION AND DESTRUCTION. Final Report, April 1, 1958–September 27, 1963. Marjorie B. Zucker (Sloan-Kettering Inst. for Cancer Research, New York). Mar. 17, 1964. Contract AT(30-1)-910. 32p.

Progress on work done on platelet production and destruction in rabbits, mice, and rats is reported. Publications resulting from this research are listed. (H.M.G.)

19471 (NYO-3140-1) THE BIOCHEMICAL CIRCULATION OF ELEMENTS IN THE SARGASSO SEA. Final Report, November 30, 1962–April 30, 1964. J. H. Ryther and D. W. Menzel (Woods Hole Oceanographic Institution, Mass.). Mar. 22, 1964. Contract AT(30-1)-3140. 7p.

Data are reported from hydrographic, chemical, and biologic measurements in the Sargasso Sea. Emphasis was placed on the role of zooplankton migration and excretion in the balance of nutrients and their vertical transports in the Sargasso Sea. The nitrogen cycle was also investigated and samples were analyzed for particulate P, particulate and dissolved Fe, phytoplankton pigments, and ^{14}C assimilation. A list is included of publications resulting from studies carried out under this contract. (C.H.)

19472 (SC-R-64-117) TEMPERATURE CONTROL IN INTERFEROMETRIC MEASUREMENTS. J. C. Moody and J. C. O'Neal (Sandia Corp., Albuquerque, N. Mex.). Mar. 1964. Contract [AT(29-1)-789]. 11p. (CONF-400-2; SC-DC-64-295)

Studies made to reduce temperature rise in an interferometric measuring chamber are described. By isolating all energy sources from the interferometer room, the conditions obtained were: the temperature of the air in the room did not vary more than $\frac{1}{40}$°C [total spread] during 24 hr; the temperature of the measuring chamber was the same within 0.01°C throughout a work day in which the lamps were left on but no measurements were made; and the temperature of the measuring chamber rose 0.32°C during a normal work day in which four to six platens of gage blocks were measured. Finally the transparent door to the measuring chamber and the entire interferometer were covered with aluminum foil, and all knobs were covered with a plastic insulating material. Now, during a normal work day the temperature of the measuring chamber stays between 19.96 and 20.03°C, and during the measurement of any one platen of gage blocks, the temperature does not fluctuate more than 0.02°C. (P.C.H.)

19473 (SC-RR-64-508) THE EFFECT ON DRAG OF USING DISTRIBUTED GRIT FOR FIXING BOUNDARY LAYER TRANSITION ON A CONE-CYLINDER MODEL AT TRISONIC SPEEDS. R. C. Maydew (Sandia Lab., Albuquerque, N. Mex.). Apr. 1964. Contract AT(29-1)-789. 31p.

The drag of a cone-cylinder, swept-fin model was measured at Mach numbers of 0.6 to 3.0 in the 12-in. trisonic wind tunnel. Measurements were made with and without 5 and 10-mil distributed roughness bands (carborundum dust) on the nose cone and the leading fin edge to fix turbulent boundary layer flow over the model. Comparison of theoretical drag estimates with the measured values indicated a turbulent boundary layer on the clean (no roughness) model at most test conditions. (auth)

19474 (SC-R-740) PHYSICAL LIMITATIONS ON THE MEASUREMENT OF TRANSIENT FIELDS IN AIR AND IN DISSIPATIVE MEDIA USING ELECTRIC AND MAGNETIC PROBES. C. W. Harrison, Jr. (Sandia Corp., Albuquerque, N. Mex.). Nov. 1963. Contract AT(29-1)-789. 9p.

The properties of electric and magnetic probes for the measurement of transient electromagnetic fields in air and in dissipative media are discussed briefly. It is shown that the effective height of an electrically small loop is independent of the ambient medium. This is also virtually true for a thin electrically short dipole (or monopole). If the open-circuit voltage of a magnetic probe can be measured accurately, it is possible (in principle) to reconstruct the time history of the incident magnetic field, even if the loop is immersed in dissipative media of unknown characteristics. The time function of the open-circuit voltage of an electric probe is essentially a replica of the time history of the incident electric field. In some schemes, the probes are lumped impedance loaded, and the voltage drop across the load impedances is measured. The source impedances of the probes are then involved in the equivalent circuits of the receiving antennas, and the leading terms in the expressions for these impedances depend on the properties of the environment. If an electrically short monopole is base-loaded by a capacitor divider, the voltage wave ap-

pearing across any capacitor is a faithful reproduction of the time sequence of the incident electric field provided the measurement is made in air or other dielectric. (auth)

19475 (SC-TM-64-56) NOISE FIGURE — PREAMPLIFIERS AND MULTICOUPLERS, WHY AND HOW MUCH. H. O. Jeske (Sandia Lab., Albuquerque, N. Mex.). Mar. 1964. Contract AT(29-1)-789. 10p.

The definition and optimization of the noise figure of an amplifier system are briefly considered, and relations are given for calculating the overall noise figure of a system. Examples are calculated to illustrate the effect of system losses preceding and following a wide band low-noise preamplifier, using typical 200 Mc telemetry component characteristics. The use of both active and passive multicouplers is also discussed. Advantages for passive multicouplers are noted. In many applications, their use would lead to a noise figure degradation of <0.5 db. (D.C.W.)

19476 (SC-TM-315-63(14)) ELECTRICAL INSULATING PROPERTIES OF VACUUM-EVAPORATED SILICON MONOXIDE FILMS. L. E. Terry (Sandia Lab., Albuquerque, N. Mex.). Nov. 1963. Contract [AT(29-1)-789]. 23p.

Variances obtained in the electrical properties of SiO_x insulating films were studied as a function of the evaporation parameters: residual pressure, evaporation rate, and thickness. The observed changes are correlated with other experimental work on ultraviolet and infrared adsorption of SiO_x to yield information as to the most probable composition of the films. Films formed at low rates and high pressures have a composition nearly that of SiO_2 and have dielectric strengths of 1 to 4×10^6 v/cm. (auth)

19477 (SCL-DR-64-41) DC GAGE HEAD READOUT CONSOLE. C. M. Furnberg (Sandia Lab., Albuquerque, N. Mex.). Mar. 1964. Contract AT(29-1)-789. 27p.

A multi-channel readout console that displays and records, in decimal form, analog information from d-c gage heads (displacement transducers) is described. The console also supplies the input power to the gage heads. (auth)

19478 (SCL-R-64-40) RANDOM VIBRATION TERMINOLOGY AND ANALYSIS EQUIPMENT. D. F. Hillyer, Jr. (Sandia Corp. Livermore Lab., Livermore, Calif.). Feb. 1964. Contract [AT(29-1)-789]. 62p.

Sandia Corp. Monograph.

A pedagogical discussion is presented of: 1) the common terms occurring in random waveform analysis and the relationships between them; 2) the equipment used to collect and measure laboratory and field data; and 3) the limitations and inaccuracies of equipment as they apply to the statistical quality of the measurements. Discussions are presented of broad and narrow-band random noise; stationarity and ergodicity; power spectral density; the accuracy of the mean-square measurement technique; and the swept-filter, real-time, and amplitude probability density analyzers. (auth)

19479 (SCL-TM-64-36) A FORTRAN PROGRAM FOR CALCULATING THE STABILITY OF FILAMENT-WOUND CYLINDERS LOADED UNDER AXIAL COMPRESSION OR RADIAL PRESSURE. L. A. Behrmann (Sandia Corp. Livermore Lab., Livermore, Calif.). Feb. 1964. Contract AT(29-1)-789. 16p.

The program FILLI for the IBM 1620 calculates the critical buckling pressure or axial load for filament-wound cylinders and small-angle conical shells and the minimum spacing required between ring stiffeners in a given filament-wound cone or cylinder for a critical radial pressure. Results obtained with the program are in reasonable agreement with experimental values. The equations and program listing are included. (auth)

19480 (TEI-831) THE ANADARKO BASIN (OF PARTS OF OKLAHOMA, TEXAS, KANSAS, AND COLORADO). M. E. MacLachlan (Geological Survey, Washington, D. C.). Mar. 1964. 99p.

The Anadarko is an asymmetrical syncline situated in parts of Oklahoma, Texas, Kansas, and Colorado and occupying an area of about 45,000 square miles. It consists of a deep trough at the south side in which there may be 33,000 ft of sedimentary rocks, an embayment area to the northwest where the section is about 9,500 ft thick in the deepest part, and a platform between these two features. The basin is outlined by positive elements on the east, south, and west sides, but the north limit is approximately located. The major economic resources found in the Anadarko area are water, oil, and gas. Geologic features of the area are described. (C.H.)

19481 (TID-7671) PROCEEDINGS OF THE CONFERENCE ON THE INTERRELATED ROLE OF UNIVERSITIES AND FEDERAL AGENCIES IN NUCLEAR EDUCATION, HELD AT GATLINBURG, TENNESSEE, AUGUST 26-27, 1963. (Atomic Energy Commission, Washington, D. C.). 136p.

The history of nuclear engineering education was reviewed. Government support of university research and instruction and the programs of the Atomic Energy Commission, National Science Foundation, National Aeronautics and Space Administration, Public Health Service, and the National Laboratories in nuclear education and training were discussed. Criteria in nuclear engineering education and future trends in nuclear education and in Federal assistance for nuclear education were considered. (C.H.)

19482 (TID-20315) THE MECHANISM OF THE HETEROGENEOUS LOW-TEMPERATURE ORTHOHYDROGEN CONVERSION. Final Technical Report. Douglas S. Chapin (Arizona. Univ., Tucson). Jan. 1964. Contract AT(11-1)-367. 116p.

Equipment and techniques for studying the ortho-to-para-conversion in hydrogen were investigated. Possible catalyst systems were studied using a Pirani gage as a microthermal conductivity cell to determine ortho-parahydrogen compositions. Conversion rate constants obtained for Nd_2O_3 supported on alumina were successfully estimated from data for oxygen absorbed on TiO_2. Different alumina, however, displayed unequal activities in the conversion. An attempt was made to determine the mechanism responsible for this occurrence. Rate data for the conversion on a gadolinium-silica gel catalyst system were also obtained. (D.C.W.)

19483 (TID-20391) NATURAL MUTATIONS AND MUTATION RATES IN THE HOUSE MOUSE. Progress Report, June 28, 1963 – February 29, 1964. Earl L. Green, Margaret M. Dickie, and Gunther Schlager (Roscoe B. Jackson Memorial Lab., Bar Harbor, Me.). Mar. 16, 1964. Contract AT(30-1)-3249. 5p.

Results are reported from preliminary studies on natural mutations and mutation rates in the house mouse. Mouse populations were examined and all pertinent data on number of deviants produced by each breeding pair were recorded and punched on IBM cards for analysis to determine natural mutation rates for coat color loci. (C.H.)

19484 (TID-20406) ECOLOGICAL CHARACTERISTICS OF A SELECTED MULE DEER WINTER RANGE.

Charles M. Loveless (Colorado Cooperative Wildlife Research Unit, Fort Collins.). Oct. 1963. Contract AT(11-1)-898. 340p.

Selected features of the physical and biological environment of a mule deer winter range, located in the Front Range of the Rocky Mountains, Larimer County, Colorado, are characterized. The response of deer to environmental factors is examined, and a technique for measuring deer activity quantitatively is suggested. (auth)

19485 (TID-20430) ANELASTIC AND DIELECTRIC RELAXATION DUE TO IMPURITY-VACANCY COMPLEXES IN NaCl CRYSTALS. R. W. Dreyfus and R. B. Laibowitz (International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.). Mar. 15, 1964. Contract [AT(30-1)-2811]. 47p. (RC-1141)

Appreciable pairing of divalent metallic impurities with Na^+ vacancies occurs in NaCl below 300°C. The reorientation of such pairs or complexes had previously been observed under an applied electric field. Stress-induced reorientation of pairs in NaCl doped with $CaCl_2$ and $MnCl_2$ has been studied by means of internal friction measurements. An internal friction peak attributed to pair reorientation under stress was observed near 100°C for a vibration frequency of ~10 kc/sec. Data obtained for longitudinal stress along both the ⟨100⟩ and ⟨111⟩ crystal directions yields information about the rates of relaxation corresponding to various mechanical relaxational modes. The data can be interpreted consistently in terms of an extension of the theory previously applied to dielectric relaxation, according to which the paired vacancy occupies only nearest neighbor (n.n.) and next-nearest neighbor (n.n.n.) sites to the impurity. Relations obtained between the relaxation rates and the various possible jump rates for a Na^+ ion into the vacancy enabled each of the specific vacancy jump rates to be determined. It is concluded that the most rapid means for the reorientation of an impurity-vacancy pair between two n.n. sites is for the vacancy to move via a n.n.n site. The rate of jump of the impurity ion into the vacancy is found to be a relatively slow process. (auth)

19486 (TID-20433) MICROBIOLOGICAL ASSAYS OF SEAWATER USING RADIOISOTOPES. Progress Report. (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory). Mar. 1964. Contract AT(30-1)-3233. 29p.

A microbiological method was developed for the assay of vitamin B_{12} in seawater using a photosynthetic marine diatom and the incorporation of ^{14}C through photosynthesis as the criterion of response to B_{12}. Several other organisms were screened for responses to B_{12} using this method. Data are given on results using Cyclotella nana, Skeletonema costatum, Amphiprora, and Gyrodinium cohnii. (C.H.)

19487 (TID-20453) BIBLIOGRAPHY OF RECENT RUSSIAN LITERATURE ON THE ECOLOGY OF THE USSR. Rexford D. Lord (Division of Biology and Medicine, AEC). Jan. 30, 1964. 27p.

Three hundred sixty-six recent Russian references on the descriptive ecology of the USSR are listed. Emphasis was placed on information suitable for quantitative descriptions of natural ecosystems representative of the entire country. (C.H.)

19488 (TID-20456) A LOCAL APPROXIMATION OF POTENTIAL ENERGY SURFACES BY SURFACES PERMITTING SEPARATION OF VARIABLES. R. A. Marcus (Brookhaven National Lab., Upton, N. Y. and Brooklyn. Polytechnic Inst.). [1964]. 28p.

It is shown that in the immediate vicinity of a potential energy minimum or saddle point, the major topographical features of a nonseparable potential energy surface can be approximated by those of a surface permitting separation of variables. Some applications of the approximation to problems involving anharmonic coupling of normal modes and n-dimensional tunneling and other calculation in reaction rate theory are considered. A comparison of tunneling rates for 1- and n-dimensional calculations supports a local approximation. (D.C.W.)

19489 (TID-20469) UPTAKE OF METALLIC IONS BY THE FRESHWATER SNAIL AUSTRALORBIS GLABRATUS. [Progress Report]. C. M. Yager (North Georgia Coll., Dahlonega). 1963. Contract AT(40-1)-2973. 77p.

Includes Appendices.

The snail Australorbis glabratus is the intermediate host of Schistosoma masoni. Efforts to eradicate this snail from infected areas of the earth have included the use of molluscicides, some of which include one or more metallic ions. Laboratory studies of the effect of Cu and other metallic ions on the snails, indicate that very low concentrations of these ions in pure water have a toxic effect, causing distress and death. The cause of this toxic effect was investigated by means of tracer uptake studies involving Cu, Cd, and Zn. Autoradiographic techniques and histological procedures were developed for use in the studies. Findings indicate that the hepatic lobules of the snail apparently accumulate metallic ions until maximum concentrations are reached. Digestive cells, which are a part of the liver of the snail, seem to break down when this concentration reaches intolerable levels, leading to the distress syndrome, and ultimately to the death of the snails. (C.H.)

19490 (UCRL-7554) IBM 1401 COMPUTER PRODUCED AND MAINTAINED WEAPON DATA SUBJECT AUTHORITY DOCUMENT. James H. Kennedy (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 23, 1964. Contract W-7405-eng-48. 12p.

A computer program for producing and maintaining weapon data subject authority headings is described. The IBM 1401 computer was used. The printout format of the subject authority document is flexible in that any heading may be provided in a two- or three-column format. The computer production of a subject heading document and cross reference cards is also very economical, even if 10 or more original copies have to be made. The expensive portion of the entire operation is involved in the editing of the updated master authority tape. (P.C.H.)

19491 (UCRL-11212) A CONTRIBUTION TO THE UNDERSTANDING OF THE PRIMARY QUANTUM CONVERSION IN PHOTOSYNTHESIS. R. H. Ruby, I. D. Kuntz, Jr., and Melvin Calvin (California. Univ., Berkeley. Lawrence Radiation Lab.; California. Univ., Berkeley; and California. Univ., Berkeley. Dept. of Chemistry). Jan. 1964. Contract W-7405-eng-48. 21p. (CONF-376-2)

From 50th Anniversary Celebration of French Biochemical Society, Paris, Apr. 1964.

A general consideration of the efficiency requirements for the quantum conversion process in photosynthesis is made. This leads to the concept that a most likely primary quantum conversion process would be an electron transfer process following molecular excitation. Model systems of the various types of known quantum conversion processes are discussed, followed by the presentation of evidence concerning the nature of the primary quantum conversion process in the photosynthetic apparatus of bacteria. That an electron transfer process is very early involved seems unambiguously established. That exciton transfer takes

place following primary quantum absorption seems also well established. Some supporting evidence is given to show that charge migration in the sense of semiconductor behavior also occurs. (auth)

19492 (AI-Trans-40) THE PHYSICAL BASES OF OXIDE RADIATORS, ESPECIALLY OF THE WELSBACH MANTLE. H. Ewest. Translated by Anthony Cornell (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.), from Gas-Wasserfach, 70: No. 36, (1927). 14p.

A general treatment is presented of the radiation properties of oxide mantles and the Welsbach mantle. The radiation laws of the blackbody are discussed. It is shown that the Welsbach mantle emit rays more economically than blackbodies at the same temperature. Oxide mixtures and the improvement of the Welsbach mantle are considered. (D.L.C.)

19493 (SC-T-64-47) SPARK PATTERNS OF ELEMENTS. Walter Baukloh. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from Arch. Eisenhuettenw., 13: 543-7(June 1940). 17p.

Thirty-nine chemical elements have been investigated as to their ability to produce spark patterns during grinding. Photographic pictures of the spark patterns were made. No direct connection between the possibility of a spark pattern emergence and the hardness or the combustion heat was detected. Theory of spark formation is discussed. The combustion process is determined largely by the quality of the reaction products. (auth)

19494 (UCRL-Trans-1015(L)) THE KINETICS OF VAPORIZATION OF AMMONIUM CHLORIDE. H. Springler. Translated by Margaret Little (Univ. of California Lawrence Radiation Lab., Livermore), from Z. Physik. Chem., B52: 90-116(1942). 23p.

The rate of vaporization of ammonium chloride in vacuum (with complete dissociation to ammonia and hydrogen chloride) is very much less than would be expected from the vapor pressure. Determination of the vaporization rate and its temperature dependence leads to the following picture: Under vapor-pressure equilibrium conditions, the vaporization from a layer of freely mobile, loosely bound molecules of ammonia and hydrogen chloride is proportional to a higher concentration (of molecules). In a vacuum, however, the slowest step—specifically, the transfer of ammonium chloride ion pairs from the crystal lattice to the surface—determines the rate. (auth)

19495 (UCRL-Trans-1027(L)) THE EFFECT OF MAGNETIC FIELDS ON THE MULTIPLICATION ACTIVITY OF CELLS IN VITRO. E. Delorenzi and G. C. Angela. Translated for Univ. of California, Lawrence Radiation Lab., Livermore from Arch. Sci. Med., 112: 501-9(1961). 11p.

Results are reported from preliminary studies of the effects of magnetic fields on mitotic division of cells in tissue cultures. (C.H.)

19496 (UCRL-Trans-1046) A NEW DUST MEASURING APPARATUS FOR EVALUATION OF AEROSOL FILTERS. Fritz Bangert. Translated for Univ. of California, Lawrence Radiation Lab., Berkeley, from Staub, 22: 105-8 (1962). 11p.

Improvements were made in the apparatus for the evaluation of filters by tyndallometric measurements of oil mists. These improvements extend the concentration range over which the concentration ratio of two mists is proportional to the intensity ratio of scattered light. (D.L.C.)

19497 (UCRL-Trans-1047) INFLUENCE OF SPEED OF FLOW, SIZE OF PARTICLE AND CONCENTRATION ON THE COLLECTION EFFICIENCY OF AEROSOL FILTERS. Fritz Bangert. Translated for Univ. of California, Lawrence Radiation Lab., Berkeley, from Staub, 23: 69-76 (1963). 25p.

Experiments were conducted to study the effects of flow, particle size, and concentration of aerosol–air mixtures on the passage quota of aerosol filters. The conditions were varied as follows: flow, 6 to 192 l/min; particle size, 0.2 to 0.6 μm; and concentration, 1.5 to 3000 mg/m^3. The results show passage maxima in all the curves which are displayed by change of one of the three variables. The characteristics of the curves are determined more by the mist properties than by the filter material. (D.L.C.)

19498 NUCLEAR POWER PROSPECTS IN TASMANIA. R. S. Rice (Hydro-Electric Commission of Tasmania). At. Energy Australia, 7: No. 1, 29-32(Jan. 1964).

The existing hydroelectric power plants and the future role of nuclear and hydroelectric power in Tasmania are discussed. (R.E.U.)

19499 DESALINATION OF WATER USING CONVENTIONAL AND NUCLEAR ENERGY. A Report on the Present Status of Desalination and the Possible Role Nuclear Energy May Play in this Field. (International Atomic Energy Agency, Vienna). Technical Report Series No. 24. 1964. 56p. STI/DOC/10/24. $1.00; Sch 21; 6s. std; F. fr. 4; DM 3.20 (IAEA)

A general review is presented of the status of desalination of water at the end of 1963. The water needs of the world are discussed with examples of areas which need water and power. The various desalination processes are considered. An outline is given of large existing plants all over the world. The design and arrangement of large desalination plants are discussed. Finally, economic considerations and conclusions are given. (D.L.C.)

19500 TWO YEARS OF VELA UNIFORM. Charles C. Bates. 34p. (CONF-418-1; CONF-419-1; CONF-420-1; CONF-421-1; CONF-422-1; CONF-402-4)

From Institute of Radio Engineers Monthly Meeting, Dallas Section, Dallas, Mar. 1962.

From Pan American Petroleum Co., Research Seminar, Tulsa, Okla., Mar. 1962.

From Geological Society of Washington Meeting, Washington, D. C., Mar. 1962.

From Symposium on Detection of Underground Objects, Materials and Properties, Fort Belvoir, Va., Mar. 1962.

From Seismological Society of America Annual Meeting, Los Angeles, Apr. 1962.

From American Geophysical Union 43rd Annual Meeting, Washington, D. C., Apr. 1962.

Progress is reported for a two-year period through 1961 of the VELA UNIFORM project. (R.E.U.)

19501 COMPACT CASCADE IMPACTS. M. Lippmann (to U. S. Atomic Energy Commission). U. S. Patent 3,127,763. Apr. 7, 1964.

A cascade particle impactor capable of collecting particles and distributing them according to size is described. In addition the device is capable of collecting on a pair of slides a series of different samples so that less time is required for the changing of slides. Other features of the device are its compactness and its ruggedness making it useful under field conditions. Essentially the unit consists of a main body with a series of transverse jets discharging on a pair of parallel, spaced glass plates. The plates

are capable of being moved incremental in steps to obtain the multiple samples. (AEC)

19502 EXPERIMENTAL ANIMAL WATERING DEVICE. M. P. Finkel (to U. S. Atomic Energy Commission). U. S. Patent 3,127,872. Apr. 7, 1964.

A device for watering experimental animals confined in a battery of individual plastic enclosures is described. It consists of a rectangular plastic enclosure having a plurality of fluid-tight compartments, each with a drinking hole near the bottom and a filling hole on the top. The enclosure is immersed in water until filled, its drinking holes sealed with a strip of tape, and it is then placed in the battery. The tape sealing prevents the flow of water from the device, but permits animals to drink by licking the drinking holes. (AEC)

19503 IMPROVED BONDING METHOD. Eustes V. Padgett, Jr., and Darl H. Warf (to U. S. Atomic Energy Commission). U. S. Patent 3,130,491. Apr. 28, 1964.

An improved process of bonding aluminum to aluminum without fusion by ultrasonic vibrations plus pressure is described. The surfaces to be bonded are coated with an aqueous solution of alkali metal stearate prior to assembling for bonding. (AEC)

CORPORATE AUTHOR INDEX

This index contains entries for this period for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

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ä	becomes	ae
ö		oe
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SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. References to report numbers, where appropriate, are included after the abstract number of the citation. Published literature (journal article or book) is indentifiable by the absence of a report number.

General Indexing Style

The user should bear in mind that the ideas presented in the original literature, rather than key words, have been indexed. The indexers have tried to select what seemed the most probable and logical place to look for typical information. Since it is not possible to anticipate where a user would look for information, numerous cross references are included to assist him in his search.

Experience in using an index of this type will be the best guide in obtaining the desired information, and a consideration of synonymous or closely related terms will prove valuable.

Information must be so indexed as to be of the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use, nor to the general class headings that include the specific headings. For example, information on the treatment of thyroid disease with I-131 would be indexed under Thyroid Diseases and under Iodine Isotopes I-131, but not necessarily under Radiotherapy. A study of the effects of x radiation on hair would be indexed under both X Radiation and Hair. However, the information would not be indexed under the experimental animal, e.g., Rats, unless the report discusses the effects on rat hair as compared with the effect on the hair of other animals.

The broad, general class headings are used only for general information or for comprehensive reports or articles.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings or, in some cases, subheadings; e.g., Amino Acids rather than Acids, amino; Helium Isotopes He-4 rather than Helium—isotopes He-4 or Helium—He-4 isotopes. Note, however, that in some cases modifying terms are used parenthetically in preference to a more direct type of entry which would result in the scattering of information. Organic compounds, however, are usually entered in the index in the inverted form so that substituted compounds can be listed near the parent compound; e.g., Benzene, Bromo- rather than Bromobenzene. In general, the style of nomenclature used is that of *Chemical Abstracts*, except that some items listed in that publication as subheadings are elevated to form part of the main heading; e.g., Butyric Acid, Methyl Ester rather than Butyric Acid—methyl ester.

Alphabetization

Main headings are arranged according to the widely accepted word-by-word alphabetic system. A parenthetic qualifier following a main heading is disregarded in alphabetizing unless there are two or more headings identical except for the parenthetic qualifier, in which case the qualifier determines the order. Headings involving Greek letters are arranged as if the names of the letters were spelled out, e.g., Mesons (π), Mesons (ζ).

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed in the direct form, listing cations in the order of increasing valence in the case of polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., Sodium Aluminum Silicates and Potassium Sodium Sulfates.

Multicomponent Systems

Multicomponent alloys, except well-known trade names are indexed under each element in the alloy.

Example: Aluminum–Chromium Alloys are indexed

ALUMINUM ALLOYS
Al–Cr ...
CHROMIUM ALLOYS
Al–Cr ...

Well-known alloys such as Hastelloy are indexed directly with cross references under the element components. Multicomponent systems of elements are indexed similarly.

Example: Silicon–Tungsten Systems are indexed

SILICON SYSTEMS
Si–W ...
TUNGSTEN SYSTEMS
Si–W ...

Multicomponent systems of compounds are similarly indexed under the compound.

Physical States of Materials

In this subject index specification of the physical state of the material, if other than normal, is included in the modifying phrase.

Modifying Phrases (Subheadings)

Descriptive phrases (modifiers), rather than ordinary subheadings, are used under the main headings to give a better indication of the material covered in an abstract than would be possible with only a word or two whenever it appears that such information would be useful. Such phrases are written so that the idea considered most important is presented first, should a not-too-awkward expression result. However, when using this index, the reader is advised to scan all modifiers under a main heading to determine whether any abstracts in addition to the most obvious should be consulted for the desired information. Many of the modifiers are designed to be read in inverted order or to be read with the main heading inserted at the position of the comma in order to obtain a meaningful phrase; e.g., Uranium—allotropic transformation temperatures of, effect of cooling rate on is read "effect of cooling rate on allotropic transformation temperatures of uranium." In many cases, the prepositions have been omitted from such phrases provided no ambiguity results from the omission.

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Atomic Energy of Canada Limited. For sale by the Technical Information Officer, Atomic Energy of Canada Limited, Chalk River, Ontario, Canada. Copies are also deposited in libraries in the United Kingdom.

National Research Council of Canada. Available from the National Research Council of Canada, Ottawa 2, Ontario, Canada.

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Atomic Energy Commission Research Establishment, Risö. Available on exchange from the Library, Danish Atomic Energy Commission, Risö, Roskilde, Denmark. Also for sale by Jul. Gjellerup, Booksellers, 87 Sölvgade, København K., Denmark.

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FRANCE

Commissariat à l'Energie Atomique. Inquiries should be addressed to Commissariat à l'Energie Atomique, Centre d'Etudes Nucléaires de Saclay, Boite Postale No. 2, Gif-sur-Yvette, Saclay, France.

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7161	18-17704	Nucleonics, 22: No. 4, 79-80(1964)
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7412	18-19285	Nucl. Sci. Eng., 18: 525-8(1964)
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9	18-18500	New York, American Inst. of Aeronautics and Astronautics, 1964, Preprint 64-24, $1.00; ORINS
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CONF-448–	**(IAEA Symposium of the Assessment of Radioactive Body Burdens in Man, Heidelberg, Ger., May 1964)**	
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437.f	18-17927	Dep.(mc)
484.e	18-17634	Dep.(mc)
524.n	18-17863	Dep.(mc)
533.i	18-18850	Dep.(mc)
588.e	18-18175	Dep.(mc)
EURAEC–		
12	18-18330	$1.60(fs), $0.86(mf) OTS
631	18-18317	Dep.(mc); $1.60(fs), $0.80(mf) OTS
687	18-19331	Dep.(mc); $1.60(fs), $0.80(mf) OTS
836	18-18318	Dep.(mc); $2.60(fs), $0.83(mf) OTS
873	18-19268	Dep.(mc); $7.60(fs), $2.39(mf) OTS
912	18-18008	Dep.(mc); $1.10(fs), $0.80(mf) OTS
917	18-18297	Dep.(mc); $2.60(fs), $0.95(mf) OTS
923	18-17999	Dep.(mc); $1.60(fs), $0.80(mf) OTS
924	18-19269	Dep.(mc); $1.60(fs), $0.80(mf) OTS
935	18-18179	See WCAP-2562
953	18-18319	Dep.(mc); $4.60(fs), $1.61(mf) OTS
966	18-18286	Dep.(mc); $1.60(fs), $0.80(mf) OTS
971	18-18418	Dep.(mc); $2.60(fs), $0.83(mf) OTS
975	18-18413	Dep.(mc); $3.60(fs), $1.40(mf) OTS
976	18-18320	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1003	18-18345	See GEAP-4411
EXP-NRX–	**(Canadian)**	
42106	18-18412	See CRFD-1164
FTD-TT–	**(Non-AEC)**	
61-277	18-19139	OTS

Report No.	Abstract No.	Availability
63-1048	18-17481	OTS
63-1049	18-17482	OTS
GEAP–	**(Misc.)**	
4320	18-19367	Dep.(mc); $14.50(fs), $6.62(mf) OTS
4411	18-18345	Dep.(mc); $5.60(fs), $1.79(mf) OTS
HASL–		
141	18-19457	Dep.; $0.50(OTS)
144	18-18041	Dep.; $4.00(OTS)
HI–	**(Non-AEC)**	
243-RR	18-18064	$16.50(OTS)
HPR–	**(Norwegian)**	
33	18-19368	Dep.(mc)
HW–		
60431	18-18869	Dep.(mc); $1.10(fs), $0.80(mf) OTS
68600-36	18-19458	Dep.; $0.50(OTS)
74884	18-18346	Dep.(mc); $5.60(fs), $1.73(mf) OTS
75223	18-19444	Dep.(mc); $3.60(fs), $1.34(mf) OTS
76973(Rev.)	18-19445	Dep.; $0.50(OTS)
77221	18-19270	$9.60(fs), $3.53(mf) OTS
77464	18-18347	Dep.; $0.50(OTS)
77465	18-18012	Dep.(mc); $1.60(fs), $0.80(mf) OTS
77912(Rev.)	18-17975	Dep.; $0.50(OTS)
78080	18-19425	Dep.; $0.50(OTS)
78701	18-18013	Dep.; $1.25(OTS)
78724	18-17772	Dep.; $0.50(OTS)
79355	18-17928	$1.60(fs), $0.80(mf) OTS
79637	18-19369	$2.60(fs), $0.92(mf) OTS
79928	18-18014	Dep.; $2.60(fs), $0.89(mf) OTS
80158	18-19426	Dep.; $0.50(OTS)
80524	18-19459	Dep.; $0.75(OTS)
80686	18-19446	Dep.(mc); $2.60(fs), $0.83(mf) OTS
80806	18-18287	Dep.(mc); $1.60(fs), $0.80(mf) OTS
HW-SA–		
2701	18-18288	$1.60(fs), $0.80(mf) OTS
3310	18-18065	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3313	18-19460	Dep.(mc); $2.60(fs), $0.89(mf) OTS
3337	18-17722	Dep.(mc); $2.60(fs), $0.89(mf) OTS
3420	18-19461	Dep.(mc); $1.60(fs), $0.80(mf) OTS
HW-tr–		
67	18-17672	Dep.(mc); $1.60(fs), $0.80(mf) JCL
IA–	**(Non-AEC)**	
862	18-18851	Dep.(mc)
IDO–		
12034	18-17723	Dep.(mc); $4.60(fs), $1.46(mf) OTS
14616	18-17929	Dep.; $0.75(OTS)
14625	18-17930	Dep.; $1.25(OTS)
14626	18-19447	Dep.; $0.50(OTS)
16912	18-17931	Dep.; $2.50(OTS)
16948	18-19271	Dep.; $0.50(OTS)
28621	18-19370	Dep.; $2.25(OTS)
IISN–	**(Belgian)**	
127	18-18180	For translation see CEA-tr-X-542
IITRI–	**(Misc.)**	
B183-16	18-18348	
IKF–	**(German)**	
9	18-19312	Dep.(mc)
IMM-NYU–	**(Misc.)**	
320	18-18453	Dep.(mc); $3.60(fs), $1.16(mf) OTS
IOI–	**(Canadian)**	
259	18-19427	Dep.; $4.00(AECL)
IPPJ–	**(Japanese)**	
18	18-19128	Dep.(mc)
19	18-19129	Dep.(mc)
IS–		
720	18-18158	Rev. Sci. Instr., 34: 1447-8(1963)
754	18-18339	Trans. Am. Soc. Metals, 57: 356-8(1964)
755	18-17859	Inorg. Chem., 3: 518-20(1964)
760	18-19428	Dep.; $2.00(OTS)
775	18-18707	Phys. Rev., 134: B424-7(1964)
833	18-19462	Dep.; $0.50(OTS)
JAERI–	**(Japanese)**	
1049	18-19371	
1054	18-19372	
1056	18-19429	Dep.(mc)
4026	18-17724	
JINR–	**(Russian)**	
D-1551	18-18636	Dep.(mc)
E-1512	18-18637	Dep.(mc)
E-1534	18-18870	Dep.(mc)
E-1550	18-18638	Dep.(mc)
P-1502	18-18504	Dep.(mc)
P-1509	18-18871	Dep.(mc)
P-1518	18-17864	Dep.(mc)
P-1521	18-18872	Dep.(mc)
P-1524	18-18639	Dep.(mc)
P-1525	18-18640	Dep.(mc)
P-1529	18-18641	Dep.(mc)
P-1532	18-18873	Dep.(mc)
P-1533	18-18642	Dep.(mc)
P-1546	18-18874	Dep.(mc)
P-1547	18-18875	Dep.(mc)
P-1549	18-18271	Dep.(mc)
P-1554	18-18133	Dep.(mc)
P-1560	18-18643	Dep.(mc)
JPRS–	**(Non-AEC)**	
23604	18-17412	$0.50(OTS)
23903	18-19451	$0.50(OTS)
23912	18-18043	$0.50(OTS)
23983	18-17483	$0.50(OTS)
KAPL–		
3017	18-18313	Dep.(mc); $4.60(fs), $1.52(mf) OTS
KFK–	**(German)**	
176	18-17976	Dep.(mc)
184	18-18247	Dep.(mc)
185	18-18876	Dep.(mc)
KR–	**(Norwegian)**	
67	18-17773	Dep.(mc)
LA–		
1180	18-18331	Dep.(mc); $10.50(fs), $4.37(mf) OTS
3045	18-19313	Dep.; $0.50(OTS)
3049	18-17725	Dep.; $0.50(OTS)
LADC–		
5629	18-18162	Rev. Sci. Instr., 35: 516-17(1964)
5659	18-19323	Dep.(mc); $2.60(fs), $0.95(mf) OTS
5778	18-19463	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5779	18-18349	Dep.(mc); $2.60(fs), $1.07(mf) OTS
5780	18-19464	Dep.(mc); $2.60(fs), $0.83(mf) OTS
5838	18-19107	Phys. Today, 16: 21-4; 26-8; 30-1(1963)
5900	18-18669	Nucl. Phys., 51: 1-26(1964)

Report No.	Abstract No.	Availability
6023	18-18289	Dep.(mc); $2.60(fs), $0.92(mf) OTS
6046	18-18557	Dep.(mc); $2.60(fs), $0.83(mf) OTS
6082	18-17774	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6143	18-18394	Phys. Rev., 134: A716-22(1964)
6228	18-19082	Phys. Letters, 9: 37-40(1964)
6239	18-18618	Dep.(mc); $2.60(fs), $1.07(mf) OTS
6263	18-19278	Dep.(mc); $1.10(fs), $0.80(mf) OTS
LAMS–		
2946	18-18066	Dep.; $2.25(OTS)
3053	18-18877	Dep.; $0.50(OTS)
3054	18-18290	Dep.; $0.50(OTS)
3057	18-18291	Dep.; $0.50(OTS)
MATT–		
231	18-18852	Dep.(mc); $1.60(fs), $0.80(mf) OTS
MET–	(Misc.)	
63/22	18-17783	For translation see NP-tr-1120
MLM–		
1160	18-19465	Dep.; $2.60(fs), $1.10(mf) OTS
1170	18-19466	Dep.; $2.60(fs), $0.86(mf) OTS
1175	18-19467	Dep.; $1.60(fs), $0.80(mf) OTS
1176	18-19468	Dep.; $1.60(fs), $0.80(mf) OTS
MND-M–	(Misc.)	
1855	18-19373	Dep.(mc); $9.10(fs), $3.32(mf) OTS
MSAR–	(Misc.)	
64-18	18-18314	Dep.(mc); $8.10(fs), $2.66(mf) OTS
64-30	18-18315	Dep.(mc); $1.60(fs), $0.80(mf) OTS
N–	(Misc.)	
63-14234	18-18619	
63-18018	18-18787	See AFCRL-63-440
63-20341	18-18292	
NAA-SR–		
8419	18-19407	Dep.(mc); $2.60(fs), $1.07(mf) OTS
NAA-SR-Memo–		
9160	18-19408	Dep.(mc); $2.60(fs), $1.04(mf) OTS
9332	18-19409	Dep.(mc); $3.60(fs), $1.22(mf) OTS
9435	18-18332	Dep.(mc); $2.60(fs), $1.01(mf) OTS
9458	18-19279	Dep.(mc); $2.60(fs), $0.83(mf) OTS
9490	18-19374	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9539	18-19410	Dep.(mc); $1.10(fs), $0.80(mf) OTS
NASA-CR–	(Non-AEC)	
26	18-18134	$1.00(OTS)
NASA-TN–	(Misc.)	
D-2120	18-18878	$1.25(OTS)
NMI–	(Misc.)	
2125	18-18293	Dep.(mc); $6.60(fs), $2.06(mf) OTS
2809	18-18350	Dep.(mc); $1.10(fs), $0.80(mf) OTS
2811	18-18351	Dep.(mc); $4.60(fs), $1.58(mf) OTS
NP–	(AEC File No. for Non-AEC Reports)	
13610	18-19130	Zh. Eksperim. i Teor. Fiz., 46: 511-30 (1964)
13613	18-19131	Dep.(mc)
13684	18-18594	
13695	18-18644	Dep.(mc)
13699	18-19132	Dep.(mc); p.189-97 of "VI° Conference Internationale sur les Phenomenes d'Ionisation dans les Gaz. Vol. IV." Paris, SERMA, 1963.
13707	18-19469	Dep.(mc)
13713	18-18505	Dep.(mc)
13714	18-19375	Dep.(mc)
13715	18-18535	Dep.(mc)
13716	18-18176	Dep.(mc)
13718	18-18558	Dep.(mc)
13722	18-18879	Dep.(mc)
13750	18-18135	
13751(Vol.I)	18-18000	
13751(Vol.II)	18-18001	
13758	18-18294	
13764	18-17865	
13766	18-17716	Dep.(mc)
13768	18-18620	
13769	18-17968	
13771	18-18414	
13772	18-19133	Dep.(mc)
13773	18-18880	
13775	18-18025	
13776	18-19134	
13777	18-19135	
13778	18-18454	Dep.(mc)
13781	18-19136	Dep.(mc)
13782	18-18645	Dep.(mc)
13783	18-18646	Dep.(mc)
13784	18-18881	Dep.(mc)
13785	18-18057	Dep.(mc)
13786	18-18026	Dep.(mc)
13787	18-18506	Dep.(mc)
NYO–		
2138-1	18-19470	Dep.(mc); $3.60(fs), $1.16(mf) OTS
2565-1	18-17473	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2766	18-17866	Dep.(mc); $9.10(fs), $3.26(mf) OTS
2910-2	18-18136	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3140-1	18-19471	Dep.(mc); $1.10(fs), $0.80(mf) OTS
3140-1A	18-17382	Dep.(mc); $10.50(fs), $4.19(mf) OTS
10267	18-18659	Nucl. Phys., 49: 345-51(1963)
10604	18-17474	Dep.; $2.75(OTS)
10707	18-17778	Dep.(mc); $7.60(fs), $2.39(mf) OTS
ORINS–		
44	18-18137	Dep.; $0.50(OTS)
ORNL–		
1320	18-19314	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3465	18-17932	Dep.; $1.75(OTS)
3484	18-18455	Dep.; $1.25(OTS)
3505	18-18507	Dep.; $1.50(OTS)
3533	18-17933	Dep.; $1.50(OTS)
3574	18-19430	Dep.; $2.50(OTS)
3576	18-18621	Dep.; $3.00(OTS)
3580	18-19280	Dep.; $2.60(fs), $0.89(mf) OTS
3583	18-19258	Dep.; $0.75(OTS)
3586	18-17934	Dep.; $0.75(OTS)
3587	18-18352	Dep.; $3.60(fs), $1.16(mf) OTS
3598	18-18316	Dep.; $0.75(OTS)
ORNL-TM–		
306	18-18456	Dep.(mc); $8.10(fs), $2.78(mf) OTS
532	18-17935	Dep.(mc); $3.60(fs), $1.22(mf) OTS
587	18-19401	Dep.(mc); $4.60(fs), $1.49(mf) OTS
714	18-19376	Dep.(mc); $2.60(fs), $1.07(mf) OTS
723	18-18457	Dep.(mc); $1.60(fs), $0.80(mf) OTS
757	18-19448	Dep.(mc); $13.50(fs), $5.96(mf) OTS
763	18-18415	Dep.(mc); $3.60(fs), $1.16(mf) OTS
793	18-17977	Dep.(mc); $3.60(fs), $1.40(mf) OTS
800	18-17936	Dep.(mc); $1.60(fs), $0.80(mf) OTS
821	18-18612	Dep.(mc); $1.10(fs), $0.80(mf) OTS
ORNL-tr–		
58	18-19140	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS

Report No.	Abstract No.	Availability
OTS–	**(Misc.)**	
62-11755/4	18-17388	$2.50(OTS)
62-11757/9-10	18-17919	$0.75(OTS)
64-21755	18-17412	See JPRS-23604
64-21915	18-19451	See JPRS-23903
64-21960	18-17483	See JPRS-23983
PAEC(D)CH–	**(Philippines)**	
638	18-17937	Dep.(mc)
PATENTS	**(British)**	**3s. 6d. each, U. K. Patent Office**
953,053	18-18167	
953,066	18-17989	
953,088	18-18309	
953,228	18-18168	
953,232	18-19289	
953,233	18-19290	
953,297	18-19291	
953,298	18-19292	
953,320	18-19397	
953,356	18-18169	
953,383	18-19293	
953,468	18-17990	
953,475	18-19337	
953,524	18-19254	
953,534	18-19294	
953,592	18-18310	
953,650	18-19295	
953,694	18-19296	
953,873	18-19338	
953,912	18-19297	
953,963	18-17849	
953,977	18-18340	
954,073	18-17991	
954,101	18-19298	
954,144	18-19299	
954,251	18-17963	
PATENTS	**(French)**	
1,297,494	18-19300	
1,304,480	18-19301	
1,305,135	18-19339	
1,305,294	18-19302	
1,305,300	18-19303	
1,305,555	18-17992	
1,309,016	18-19398	
1,311,719	18-19419	
1,312,809	18-17993	
1,313,183	18-17994	
1,313,263	18-19326	
1,314,775	18-19327	
1,315,685	18-19304	
1,315,918	18-17964	
1,317,515	18-19340	
1,320,454	18-19305	
1,321,767	18-19399	
1,322,236	18-17995	
1,322,620	18-19306	
PATENTS	**(U. S.)**	
3,120,304	18-18053	
3,121,052	18-19400	
3,127,046	18-19307	
3,127,236	18-17965	
3,127,287	18-18631	
3,127,319	18-19404	
3,127,320	18-19308	
3,127,321	18-19420	
3,127,322	18-19421	
3,127,323	18-19422	
3,127,324	18-19328	
3,127,325	18-19443	
3,127,336	18-18268	
3,127,502	18-19255	
3,127,505	18-18170	
3,127,511	18-18054	
3,127,512	18-18055	
3,127,515	18-18130	
3,127,528	18-18632	
3,127,763	18-19501	
3,127,872	18-19502	
3,128,234	18-19341	
3,128,405	18-18532	
3,129,329	18-18243	
3,130,306	18-18244	
3,130,307	18-18861	
3,130,315	18-18748	
3,130,491	18-19503	
3,131,139	18-17920	
PATENTS	**(U.S.S.R.)**	
157,784	18-17966	
158,026	18-19256	
158,028	18-18131	
158,267	18-17850	
159,238	18-18245	
159,239	18-18246	
PG-Report–	**(British)**	
546	18-17728	Dep.
564	18-17729	Dep.
569	18-17730	Dep.; $0.30(BIS); 1s. 9d.(HMSO)
576	18-17731	Dep.
PUC–		
1963-113	18-19099	Phys. Rev., 134: B322-30(1964)
1963-117	18-19104	Phys. Rev., 134: B378-82(1964)
PWA–	**(Non-AEC)**	
2170	18-18622	$19.75(OTS)
RADC-TDR–	**(Misc.)**	
62-464(Vol.I)	18-18622	See PWA-2170
RC–	**(Misc.)**	
1141	18-19485	See TID-20430
REIC-ACCESS–	**(Non-AEC)**	
72	18-18416	$3.60(OTS)
RM–	**(Misc.)**	
4037-PR	18-18788	Dep.(mc)
RRL–		
128	18-18567	J. Chem. Phys., 40: 2035-6(1964)
RT-CHI–	**(Italian)**	
(63)-34	18-17938	Dep.(mc)
RT-ING–	**(Italian)**	
(63)-19	18-19411	Dep.(mc)
RT-PROT–	**(Italian)**	
(63)-14	18-18042	Dep.(mc)
RTD-TDR–	**(Non-AEC)**	
63-4015	18-18138	
SB–	**(Non-AEC)**	
410(Suppl.1)	18-17969	$0.10(OTS)
411(Suppl.1)	18-18015	$0.10(OTS)

Report No.	Abstract No.	Availability
SC–	(Misc.)	
4972(RR)	18-17779	Dep.; $0.75(OTS)
SC-DC–		
64-295	18-19472	See SC-R-64-117
64-344	18-18458	Dep.(nc); $13.50(fs), $6.14(mf) OTS
SC-DR–		
281-63	18-18295	Dep.(nc); $1.60(fs), $0.80(mf) OTS
SC-R–		
64-117	18-19472	Dep.(nc); $1.60(fs), $0.80(mf) OTS
740	18-19474	Dep.(nc); $1.10(fs), $0.80(mf) OTS
SC-RR–		
64-19	18-17970	Dep.(nc); $1.10(fs), $0.80(mf) OTS
64-67	18-17780	Dep.(nc); $1.25(OTS)
64-508	18-19473	Dep.(nc); $3.60(fs), $1.16(mf) OTS
SC-T–		
64-47	18-19493	Dep.(nc); $1.60(fs), $0.80(mf) JCL
SC-TM–		
64-536	18-18020	Dep.(nc); $1.10(fs), $0.80(mf) OTS
64-56	18-19475	Dep.(nc); $1.10(fs), $0.80(mf) OTS
315-63(14)	18-19476	Dep.(nc); $2.60(fs), $0.89(mf) OTS
SCL-DR–		
64-41	18-19477	Dep.(nc); $2.60(fs), $1.01(mf) OTS
SCL-R–		
64-40	18-19478	Dep.; $1.75(OTS)
SCL-TM–		
64-36	18-19479	Dep.(nc); $1.60(fs), $0.80(mf) OTS
SGAE-BL–	(Austrian)	
1/1964	18-17867	Dep.(nc)
2/1964	18-17475	Dep.(nc)
SIT–		
121	18-19137	Dep.(nc); $1.60(fs), $0.80(mf) OTS
SLAC-PUB–		
19	18-18529	Rev. Sci. Instr., 35: 481-5(1964)
SM–	(Misc.)	
51-2	18-17677	See CONF-453-2
SRB–	(Non-AEC)	
62-6	18-17476	$2.60(OTS)
STI-DOC–	(International Atomic Energy Agency)	
10/23	18-18052	$1.00; Sch 21; 6s. stg; F. fr 4; DM 3.20 (IAEA)
10/24	18-19499	$1.00; Sch 21; 6s. std; F. fr. 4; DM 3.20 (IAEA)
STI-PUB–	(International Atomic Energy Agency)	
21/10	18-19125	$8.00; Sch 168; 48 s.stg; F.fr. 32; DM 28 (IAEA)
78(Vol.I)	18-18114	$10.00; Sch 210.-; 60 s.stg; F.fr. 40.-; DM 35.- (IAEA)
TEI–		
831	18-19480	Dep.(nc); $8.60(fs), $3.17(mf) OTS
TID–		
3098	18-17477	Dep.; $15.00(OTS)
7671	18-19481	Dep.; $2.50(OTS)
18472	18-18545	J. Geophys. Res., 69: 1159-68(1964)
19042	18-19012	Nucl. Phys., 50: 621-8(1964)
19043	18-19013	Nucl. Phys., 50: 629-40(1964)
19048	18-19011	Nucl. Phys., 50: 604-20(1964)
19151	18-18969	Nucl. Phys., 49: 537-43(1963)
19244	18-18992	Nucl. Phys., 50: 267-72(1964)
19344	18-17786	Anal. Chim. Acta, 30: 308-9(1964)
19384	18-18890	Ann. Phys., (N.Y.), 27: 13-57(1964)
19474	18-18033	J. Geophys. Res., 69: 1413-19(1964)
20089	18-18690	Phys. Letters, 8: 368-70(1964)
20152	18-18440	Phys. Rev., 134: A589-95(1964)
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